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3. Scientific and technical articles prepared by employees of NASA and its contractors that appear in the learned and technical journals.

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Organizations having contractual relations with NASA may obtain *IAA* by writing NASA, Code ATSS-A, Washington, D.C. 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y., 10017

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Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics. 1064

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04 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles. 1069

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09 ELECTRONICS
Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State. **1098**

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11 FLUID DYNAMICS
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A Semimonthly Publication of the National Aeronautics and Space Administration

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Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

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FUTURE TRENDS IN SOVIET SCIENCE AND TECHNOLOGY, REVIEW OF SOVIET-BLOC LITERATURE

7 Feb. 1963 286 p

(AID-P-63-2; AD-299103) OTS: $18.00 ph $8.78 mf

This report is divided into the following parts: (1) general information; (2) astrophysics and space sciences; (3) atomic energy; (4) automation and computers; (5) biology; (6) earth sciences and meteorology; (7) electronics and electricity; (8) metallic materials; (9) nonmetallic materials; (10) physics; and (11) scientific administration, organization, and education. P.V.E.

N64-17013 American Inst. of Aeronautics and Astronautics, New York, N.Y.

AIAA AERODYNAMIC TESTING CONFERENCE

[1964] 243 p refs Conf. held at Washington, D.C., 9–10 Mar. 1964

AIAA: $5.00 members, $10.00 nonmembers

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N64-17173 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
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N64-17176 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
JOURNAL OF ENGINEERING PHYSICS (SELECTED ARTICLES) VOL. 5, NO. 9, SEP. 1962
5 Apr. 1963 18 p refs Transl. into ENGLISH from Inzhenerno-Fiz. Zh. (Minsk) v. 5, no. 9, Sep. 1962 p 25–32 and 81–84
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N64-17217 Naval Research Lab., Washington, D.C.
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N64-17262* National Aeronautics and Space Administration, Washington, D.C.
CONTRACT NUMBER INDEX TO REPORTS ANNOUNCED IN STAR. CUMULATIVE INDEX TO ITEMS IN TPA VOLUME 2 AND STAR VOLUME 1, 1962-1963
[1964] 197 p
(NASA SP-7001) OTS: $3.00

This Contract Number Index provides a guide to contract-generated scientific and technical reports announced in Scientific and Technical Aerospace Reports (STAR) Volume 1 and its predecessor Technical Publications Announcements (TPA) Volume 2. Reports generated under Government contract, grant, or order are listed by accession number. For ease of use, two separate listings are provided. The first listing, Contract Number–Corporate Source Index, is arranged in primary order by contract numbers with corresponding corporate sources. The second listing, Corporate Source–Contract Number Index, is arranged in primary order by corporate source with the contract numbers and corresponding accession numbers given. I.v.L.

N64-17288 Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON COMPUTER AUGMENTED INFORMATION MANAGEMENT
Charle P. Bourne Bedford, Mass., Electron. Systems Div., Nov. 1963 59 p refs
(Contract AF 19(628)-2914)
(ESD-TDR-64-177; AD-432098)

The work was concerned primarily with the design and development of an information-management subsystem that would operate in the environment of a cooperative man–computer system for the production of operating computer programs. An experimental system was developed that utilized the AN/FSQ-32 computer in a time-sharing mode of operation, as well as a cathode ray tube display and associated input–output facilities for real-time machine use by a programer. A number of symbol manipulation techniques (e.g., insert, delete) were used for the editing and manipulation of text and programing material on the display. Procedures were established for obtaining and using machine-readable records from all of the project records (e.g., memos, correspondence, bibliographies, reports) generated by the user group, to serve as the basis for an experimental machine file. This machine file was established along with appropriate file search routines, to permit the reading of the natural text of the file material. Author

N64-17334 Aerospace Corp., El Segundo, Calif. Engineering Div.
SOME CONSIDERATIONS ON PARTS, MATERIALS AND PROCESS ENGINEERING FOR MILITARY SYSTEMS
Douglas O. Heitkamp 23 Jan. 1964 24 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-3; TDR-269(4303)-9; AD-432465) OTS: $2.60

This report examines certain aspects of parts, materials, and process engineering technology. Based upon this examination, several recommendations are developed that should be helpful to program office, engineering staff, and procurement management personnel. Author

N64-17342 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 75
19 Mar. 1964 83 p refs Transl. into ENGLISH of 10 articles (JPRS-23767; OTS-64-21840) OTS: $2.25

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10. THE CANTON INSTITUTE OF CHINESE MEDICINE Hai-t'ien p 78–80 refs

N64-17440 Bendix Corp., Holmdel, N.J. Bendix Semiconductor Div.
PRODUCTION RELIABILITY IMPROVEMENT PROGRAM FOR GERMANIUM TRANSISTOR 2N1430 – PRODUCTION ENGINEERING MEASURE, VOLUME II Final Report, 30 Apr. 1962-31 Oct. 1963
[1963] 261 p
(Contract DA-36-039-SC-86723)
(AD-432315)

This quality control manual contains discussions of the following: (1) management and organization; (2) purchased materials, tools, and gages; (3) process control; (4) discrepant material control; (5) special processes (plating, radiographic inspection, production tooling, and welding); (6) final product acceptance; (7) product acceptance–reliability; (8) electrical standards–calibration; (9) packaging and shipping; (10) engineering control; (11) sales procedure; (12) purchasing control; and (13) standard forms (form listings). I.v.L.

N64-17523 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md. Chemical Propulsion Information Agency
PROCEEDINGS OF THE SEVENTH MEETING OF THE ICRPG WORKING GROUP ON DESIGN AUTOMATION
Ronald D. Brown Feb. 1964 30 p Proc. held at NASA, Ames Res. Center, Moffett Field, Calif., 28 Jan. 1964
(Contract NOw-62-0604-c)
(CPIA Publ. 45; AD-433078)

Reports from the following subcommittees are presented: performance subcommittee; design subcommittee; evaluation subcommittee; nomenclature subcommittee; and the program inventory and information retrieval committee. The following papers are presented in the appendix: (1) Search Catalogs; and (2) Technical Requirements for Rocket Motor Reliability Estimation and Evaluation Program. P.V.E.

N64-17597 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
LIST OF R.A.E. TRANSLATIONS ISSUED UP TO 31st DECEMBER 1962
S. W. Salt, comp. London, Min. of Aviation, May 1963 95 p 1023 refs
(RAE LIB-BIBL-243)

This list is the last complete list of R.A.E. Translations to be issued. Author

N64-17615 Aerospace Corp., El Segundo, Calif.
A DIGITAL SIMULATION PROGRAM FOR THE INTERCEPTION OF A TARGET BY AN INTERCEPTOR USING PROPORTIONAL NAVIGATION SCHEMES
J. P. Janus and W. J. Wollenberg 31 Jan. 1964 53 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-7; TDR-269(4540-50)-2; AD-433049)

This digital simulation program may be used to study the boost, midcourse, and homing phase of the interception of a target by an interceptor using proportional navigation. Given the initial positions, velocities and accelerations of the target and the interceptor, the target acceleration profile, and guidance parameters for the interceptor guidance system, this program computes a homing intercept trajectory based upon maintaining a zero line-of-sight rate between the target and itself. The equations of motion are written in a relative coordinate system fixed on the target position. The option of biased proportional navigation is also available. Homing thrust orientation is obtained by either of two methods: Roll-to-turn and Y configuration (3 engines) with a roll capability. Author

N64-17628 Lincoln Lab., Mass. Inst. of Tech., Lexington
DATA SYSTEMS Division 2, Quarterly Progress Report, 1 Aug.-31 Oct. 1963
C. R. Wieser et al 9 Dec. 1963 19 p refs
(Contract AF 19(628)-500)
(ESD-TDR-63-575; AD-425576)

This report includes discussions of: (1) magnetic-tape storage, a high-speed printer, and an optical input for the TX-2 digital computer; (2) computer programs that provide automatic analysis, simulation, and flow charting; (3) circuit development—flip-flop memory, circuits, circuit-card plug-in trays, a miniature coaxial cable, and UHF switching transistors; (4) magnetic film engineering—a 1024-word, 13-digit memory; paired magnetic films; and film memory; (5) computer components—magnetic films, electron transport, and an analog-to-digital converter; (6) automatic speech recognition; (7) human information processes; (8) a new digital monopulse radar processor; (9) an iterative technique for estimating the maximum peak of a multipeak power spectrum of a stationary time series; and (10) the control of a moving mass, subjected to quadratic drag forces pertinent to the launch and maneuver of space vehicles within the atmosphere. Also, a list of the reports issued during the present reporting period is presented. I.v.L.

N64-17629 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADIO PHYSICS Division 3, Quarterly Progress Report 1 Aug.-31 Oct. 1963
J. W. Meyer et al 11 Dec. 1963 13 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-574; AD-425670)

Activities in the following areas are reported: (1) surveillance techniques—millstone L-band radar system, radiometer observations, incoherent ionospheric backscatter observations; (2) radio propagation—El Campo solar radar (data analysis and operations at El Campo); and (3) plasma physics—launch phase simulation, including gaseous discharge experiments, and spherical shock waves. R.T.K.

N64-17797* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HISTORY OF THE GEORGE C. MARSHALL SPACE FLIGHT CENTER FROM JANUARY 1 THROUGH JUNE 30, 1963, VOLUME TWO: SUPPORTING DOCUMENTS MSFC Hist. Monograph No. 7
Nov. 1963 90 p refs
(NASA TM X-51524; MHM-7) OTS: $8.10 ph, $2.90 mf

The following are included in this volume: (1) applied costs of research and development budget line items; (2) total MSFC manpower summary; (3) personnel assignments within MSFC; (4) incentive-awards program data; (5) patents issued to MSFC employees; (6) test division's historical report, January 1 through June 30, 1963; (7) Michoud operations historical report, January 1, 1963, through June 30, 1963; (8) Mississippi test operations historical report, January 1 through June 30, 1963; and (9) Saturn illustrated chronology. R.T.K.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-16921 College of Aeronautics, Cranfield (Gt. Brit.)
SLIP FLOW PAST SLENDER POINTED BODIES
C. B. Stribling May 1963 34 p refs
(CoA-160)

Using Oseen's approximation to linearize the Navier–Stokes equations, a solution to the problem of axisymmetric slip flow past slender bodies of revolution at zero incidence has been obtained. The drag coefficient has been evaluated for both incompressible and compressible flows, and this has been compared with normal boundary-layer values. It is found that the skin friction drag is the dominant component of drag in the incompressible case and in the compressible case.
Author

N64-16939 Aeronautical Research Council (Gt. Brit.)
TUNNEL TESTS ON A DOUBLE CASCADE TO DETERMINE THE INTERACTION BETWEEN THE ROTOR AND THE NOZZELS OF A SUPERSONIC TURBINE
B. S. Stratford and G. E. Sansome London, HMSO, 1963 21 p refs
(ARC-CP-693) Available from HMSO: 4s 6d.

The present test cascade represented the stationary configuration of a turbine of 2.5 nozzle Mach number and 74° swirl angle, the rotors being designed to operate at 1.9 relative Mach number and to provide a turning angle of 140°. In the tests, fully supersonic flow could be established through the system, but the losses were fairly high and an increase in loss of about 25% would have caused choking in the rotor. The flow in the nozzles appeared well behaved. According to the Schlieren photographs the individual shock waves from the leading edges of the rotors were fairly well attenuated before reaching the nozzle exit, with the result that, for a given exit angle, the flow in the nozzles appeared to be unaffected by the presence of the rotors. The gas exit angle from the nozzles and hence the incidence on the rotors were determined as expected by conditions downstream, in this instance the leading edge of the rotor blades. Considerable secondary flow occurred in and just ahead of the rotor blades at the ends of the span. Author

N64-16946 Training Center for Experimental Aerodynamics, Rhode-Saint-Genese (Belgium)
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE DESIGN AND PERFORMANCE OF A PLUG-TYPE NOZZLE
G. Angelino Jul. 1963 86 p refs
(TCEA-TN-12)

A plug-type nozzle has been designed and its performance estimated by classical methods. Measurements were made experimentally of the performance of a model nozzle at both design and off-design operational conditions, and were found to agree with predicted values. It was found that a plug nozzle can be made considerably shorter than a conventional nozzle of the same thrust, and that its performance is little affected by operation at off-design conditions or when the plug is truncated.
Author

N64-16975 Aeronautical Research Inst. of Sweden, Stockholm
THE FLOW FIELD ABOUT A HEMISPHERE-CYLINDER BODY AT A MACH NUMBER OF 7.3
Peter G. Wilby Nov. 1962 13 p refs GERMAN, FRENCH summaries
(Contract AF 61(052)-75)
(FFA-92; Tech. Note-7; AD-298668)

A method is presented for evaluating the flow field around a blunt-nosed body of revolution, from stagnation pressure measurements and bow-shock shape. Results obtained by applying this method to a hemisphere-cylinder body at a Mach number of 7.3 are given and compared with results given by approximate theory.
Author

N64-17128 ARO, Inc., Arnold Air Force Station, Tenn.
THE INFLUENCE OF SLIGHT LEADING-EDGE BLUNTNESS ON BOUNDARY-LAYER TRANSITION AT A MACH NUMBER OF EIGHT
Jack D. Whitfield and J. Leith Potter (von Karman Gas Dynamics Facility) Arnold Eng. Develop. Center Mar. 1964 28 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-18; AD-431533)

The influence of leading-edge geometry on boundary-layer transition on a hollow cylinder aligned with the flow has been studied under hypersonic conditions with near adiabatic wall temperature. Effects on the Reynolds number of boundary-layer transition produced by varying free-stream unit Reynolds number and small degrees of leading-edge bluntness are shown to be qualitatively similar to results previously reported by the authors for Mach numbers of 3 to 5. There was a pronounced favorable effect associated with increases in both factors. Comparisons are made with the theoretical estimates of the influence of bluntness given by

Moeckel. Although qualitative agreement with Moeckel's theory is noted, quantitative agreement is not shown, and some doubt concerning the theory is expressed. Author

N64-17145 McDonnell Aircraft Corp., St. Louis, Mo.
AXIAL COMPRESSION TEST – UPPER TORQUE BOX SKIN WHEEL BUMP FAIRING
R. Geutemann 10 Mar. 1964 14 p
(Contract AF 33(657)-11215)
(A-487; AD-431865)

A 53-010001 wheel bump fairing test panel was subjected to a hot-air blast that produced temperatures of 275° to 305° F (at the surface), and dynamic pressures of 15 psig. An air blast was directed to the EC 1675 and fiber glass fairing juncture, and to the aluminum-filled fairing compound and the skin juncture. Each juncture was subjected to 25 cycles of combined heating and air blast and cooled to 100° F between cycles. No significant damage occurred in either of the areas. Author

N64-17158* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INDUCED PRESSURES AND SHOCK SHAPES ON BLUNT CONES IN HYPERSONIC FLOW
Richard D. Wagner, Jr., and Ralph Watson Washington, NASA, Mar. 1964 27 p refs
(NASA TN D-2182) OTS: $0.75

Numerical solutions and experimental pressure distributions have been studied with the intention of evaluating proposed extensions to the case of blunt cones of the blast-wave correlation of induced pressures. The numerical inviscid solutions obtained by characteristics theory correlate in terms of what may be considered as modified blast-wave parameters. The correlation of experimental pressures, though not as successful as that for the inviscid numerical solutions, is reasonably good. A secondary study of Reynolds number effects indicates that the poorer correlation of the experimental pressures is due, in part, to viscous effects. The experimental shock shapes are also obtained and found to give a good correlation for small cone angles in terms of blast-wave-type parameters, but the correlation deteriorates for cone semivertex angles near 20° and above. Much of the success is implied by previous blast-wave correlations of shock shapes on blunt cylinders, together with the limited independence of afterbody geometry in the shock shape. Author

N64-17178 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
LEAKAGE OF GAS INTO A LIQUID THROUGH THE LAVAL NOZZLE
M. G. Moiseyev *In its* J. of Eng. Phys. (Selected Articles) v. 5, no. 9, Sep. 1962 4 Apr. 1964 p 11–15 refs (See N64-17176 09-01)

The discharge of a supersonic air stream into water was investigated. Pressure measurements were made using a specially prepared pitot tube with electric heating. Total pressure measurements along the axis and in the transverse directions of the gas stream were made at various flow velocities. Results indicate that: (1) There are two sharply differing sections in a gas stream discharged into water. There is the initial section of the stream in which sharp pressure fluctuations are observed, and a basic section on which a smooth pressure drop is observed. (2) The nature of pressure fluctuations along the axis of the stream, and their value, and the length of the entire initial section of the supersonic air stream, flowing into water and into air, are in quite accurate conformity. This indicates that, within the limits of the initial section of the air flow propagating in water, there is retained the very same configuration of shock waves as in a stream being discharged into air. This, in turn, indicates that within the limits of the initial section there is no intensive mixing of the two phases. (3) Pressure measurements along the profile of the stream show that there is no sharp expansion along the axis of the stream in the zone of high pressures. (4) A sharp expansion of the stream and a wide zone of lower total pressures were observed along the periphery of the stream. I.v.L.

N64-17248 Aeronautical Research Council (Gt. Brit.)
ATOMIC RECOMBINATION IN NOZZLES: METHODS OF ANALYSIS FOR FLOWS WITH COMPLICATED CHEMISTRY
K. N. C. Bray and J. P. Appleton London, HMSO, May 1961 40 p refs
(ARC-CP-636; supersedes AASU-166, AASU-178, ARC-22-828, ARC-22-905) HMSO: 7s 6d

The object of this review is to study the feasibility of performing accurate calculations on the nonequilibrium flow of a complicated gas mixture through nozzles, with particular reference to the propulsive nozzle of the hypersonic ramjet. Equations are given for the steady, quasi-one-dimensional, adiabatic flow of a general reacting gas mixture, consisting of n species related through N chemical reactions. A number of alternative methods of obtaining numerical solutions to these equations are described and evaluated. The formulation of the system of chemical reactions is also discussed, together with the availability of the large amount of thermodynamic and chemical kinetic data that is required before a numerical solution can be attempted. It is found that by far the most serious difficulty to be overcome, before accurate nonequilibrium nozzle calculations can be performed, is obtaining reliable data on the rates of the many chemical reactions that may be involved. Author

N64-17280 California U., Berkeley Inst. of Engineering Research.
CYLINDER DRAG IN THE HYPERSONIC FREE JET OF A RAREFIED AIR STREAM
Stephen Shien-Pu Tang (M.S. Thesis) 30 Jan. 1964 48 p refs
(Contract Nonr-222(45))
(AS-64-3; AD-431774) OTS: $4.60

Drag forces on circular cylinders normal to axisymmetric jets issuing from sonic orifices have been measured. Suitable corrections have been developed to account for the radial gradients produced by the source-like flow, thus permitting comparisons of the present data with data obtained using a uniform flow-field jet. With properties on the axis of the jets as reference, the data are presented in coefficient form at Mach numbers of 5.92, 6.30, 8.02, and 9.85. With Knudsen numbers extending from 1.5 to 30, these data cover the near-free-molecule and free-molecule flow regimes. The results indicate a smooth monatomic transition and agree well at M = 5.92 with previous results obtained in uniform flows. At all Mach numbers, they agreed with theoretical free-molecule flow predictions for diffuse reflections at the highest Knudsen numbers attained. Cylinder temperatures were also measured at the same flow conditions as the drag-force measurements. Author

N64-17329 Princeton U., N.J.
AN EXPERIMENTAL INVESTIGATION OF LAMINAR HYPERSONIC CAVITY FLOWS. PART II: HEAT-TRANSFER AND RECOVERY FACTOR MEASUREMENTS

K. M. Nicoll Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Jan. 1964 44 p refs
(Contract AF 33(616)-7629)
(ARL-63-73, Pt. 2; AD-430710)

An experimental investigation has been made of the recovery factor and heat-transfer distributions on a set of cone models incorporating annular cavities. The cone-surface Mach number was 6.5, the free-stream Mach number was 11.2, and all experiments were carried out in helium. All cavity flows were "open," and all heat-transfer tests were in the laminar regime. The results show that the recovery factor in laminar, hypersonic cavity flow is almost constant within the cavity and downstream of reattachment, and is very close to the laminar attached-flow value. In the immediate vicinity of reattachment, the recovery factor is slightly higher than this value (less than 5%). The lowest values of the heat-transfer coefficient are found on the cavity floors, where a minimum of about 10 to 20 percent of the attached-flow value is reached. The highest values of the heat-transfer coefficient are in the immediate vicinity of reattachment. Author

N64-17488 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
GROWTH OF REGULAR DISTURBANCES IN AXISYMMETRIC LAMINAR AND TURBULENT WAKES
R. E. Kronauer 19 Feb. 1964 68 p refs
(Contract AF 04(694)-239)
(RAD-TM-64-3; AD-430524)

Periodic patterns of varying degrees of regularity have long been observed in the wakes of bodies such as spheres and cylinders at moderate Reynolds number and low Mach number. They have also been observed recently in the laminar and turbulent wakes of hypersonic projectiles. The rate of disturbance growth calculated from inviscid theory can be used to give an upper limit to the length of laminar wake before transition to turbulence occurs and to estimate the rate of lateral growth of the subsequent turbulent wake. Both results agree satisfactorily with experiment. Inviscid theory also gives an estimate of the lowest Reynolds number at which a sphere will exhibit a periodic wake in incompressible flow. Author

N64-17525 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
PRESSURE MEASUREMENTS FOR MACH FIVE FLOWS OVER A BLUNT PYRAMIDAL CONFIGURATION WITH AERODYNAMIC CONTROLS. PART OF AN INVESTIGATION OF HYPERSONIC FLOW SEPARATION AND CONTROL CHARACTERISTICS
Louis G. Kaufman Wright-Patterson AFB, Ohio, AF Flight Dynamics Lab., Jan. 1964 250 p refs
(Contract AF 33(616)-8130)
(RTD-TDR-63-4239; AD-431194)

Pressure data were obtained for Mach 5 flows over a blunt pyramidal configuration composed of a 70° sweepback delta-wing surface and two dihedral surfaces. Trailing-edge flap deflections were varied up to 40° on all surfaces, and the model was tested with and without canards and ventral fins. The model was pitched at angles-of-attack from −30° to +45° and at sideslip angles up to 15° for a Reynolds number, based on model length, of 4.6 million. Author

N64-17526 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
PRESSURE AND HEAT TRANSFER MEASUREMENTS FOR MACH 8 FLOWS OVER A BLUNT PRYAMIDAL CONFIGURATION WITH AERODYNAMIC CONTROLS. PART I: PRESSURE DATA FOR DELTA WING SURFACE
Louis G. Kaufman Wright-Patterson AFB, Ohio, AF Flight Dynamics Lab., Jan. 1964 154 p refs
(Contract AF 33(616)-8130)
(FDL-TDR-64-2, Pt. I; AD-431195)

Pressure and heat-transfer data were obtained for Mach 8 flows over a blunt pyramidal configuration composed of a 70° sweepback delta-wing surface and two dihedral surfaces. Trailing-edge flap deflections were varied up to 40° on all surfaces, and the model was tested with and without canards and ventral fins. The model was pitched at angles-of-attack between ±54 degrees and was tested at sideslip angles of 0° and 12° for free-stream Reynolds numbers, based on model length of 1.5 and 4.5 million. Author

N64-17547 Royal Inst. of Tech., Stockholm (Sweden)
TRAVEL REPORTS CONCERNING FATIGUE RESEARCH RELATED TO FRACTURE MECHANISMS AND AEROTECHNOLOGICAL PROBLEMS [RESEBERATTELSER OM UTMATTNINGSFORSKNING RORANDE SAVAL BROTTMEKANISM SOM FLYGTEKNISKA PROBLEMSTALLNINGAR]
Lars-Eric Jarfall 1963 56 p In SWEDISH
(Publ. 141)

This report contains a summary of the Crack Propagation Symposium held at Cranfield, England, in September 1961 and of the International Conference on Fracture held at Lake Wilderness, Seattle, Washington, in August 1962. It also summarizes visits made at various research centers, laboratories, universities, and aircraft manufacturers in the United States in the summer of 1962. P.F.E.

N64-17575* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
HYPERSONIC BALLISTIC RANGE RESULTS OF TWO PLANETARY ENTRY CONFIGURATIONS IN AIR AND CARBON DIOXIDE/NITROGEN MIXTURES
Peter Jaffe 31 Jan. 1964 12 p refs
(NASA Contract NAS7-100)
(NASA CR-53232; JPL-TR-32-543) OTS: $1.60 ph, $0.80 mf

Tests were performed at velocities of 15,500 fps in the Ballistic Range of the Naval Ordnance Laboratory (NOL) in order to determine the effects of carbon dioxide on aerodynamic characteristics. Two configurations were tested; both were spherically blunted cones with flat bases. The resultant aerodynamic data indicate no appreciable effect on drag and stability due to carbon dioxide. They correlated well with existing information obtained at lower Mach numbers and show a slight decrease in stability with increasing Mach number. Author

N64-17813* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF LAMINAR-BOUNDARY-LAYER DISPLACEMENT ON A HEMISPHERE IN HELIUM FLOW
Davis H. Crawford Washington, NASA, Apr. 1964 26 p refs
(NASA TN D-2193) OTS: $0.75

Effects of laminar-boundary-layer displacement have been calculated for the hypersonic flow of helium over a hemisphere for stagnation Reynolds numbers from 10^3 to 2×10^5 and for ratios of wall-to-stagnation enthalpy of 1.0 and 0.1. The displacement effects were greatest for the hot-wall condition in the region near the shoulder and increased the heat transfer in this region as much as 50 percent. A comparison was made with estimated vorticity effects, which gave a maximum increase in heat transfer in the stagnation region. In a hot-wall

case, for which vorticity increased the stagnation point heating rate by 1 percent, the heating rate at the 90° station was increased 20 percent because of displacement effect. Author

N64-17819* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
OBTAINING FREE-FLIGHT DYNAMIC DAMPING OF AN AXIALLY SYMMETRIC BODY (AT ALL ANGLES-OF-ATTACK) IN A CONVENTIONAL WIND TUNNEL
Peter Jaffe 15 Jan. 1964 43 p refs
(NASA Contract NAS7-100)
(NASA CR-53366; JPL-TR-32-544) OTS: $4.60 ph, $1.49 mf

Two methods are presented for calculating the dynamic damping parameter, $Cm_q + Cm_{\dot{\alpha}}$, from a novel wind-tunnel free-flight technique. The two methods, which are applicable to nonlinear, high angle-of-attack motion, are: (1) a computer method for nonplanar, nonsymmetrical motion requiring iterations; and (2) a noncomputer solution applicable when the model exhibits planar motion. Both methods assume that the static aerodynamic coefficients are known. The basic hypothesis of the planar solution is that the second-order effects can be determined by assuming that the instantaneous oscillatory frequency is a function of a nonlinear pitching moment of the form $M \sin(k\alpha)$. Both methods are applied to representative problems, and solutions using the planar method are compared with results from the computer program. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-16920 College of Aeronautics, Cranfield (Gt. Brit.)
A THEORY FOR SLENDER DELTA WINGS WITH LEADING EDGE BLOWING
C. M. P. Morgado (Portuguese AF) and A. H. Cravin (RAF Tech. Coll.) [1963] 38 p refs
(CoA-AERO-169)

Mangler and Smith's model for the flow about a slender delta wing with leading-edge separation is extended to the case of a thin jet sheet blown in a spanwise direction from the leading edge. Assuming conical flow, it is shown that the pressure distribution and the normal force coefficient can be expressed in terms of seven parameters which can be determined from seven nonlinear simultaneous equations given the incidence, sweepback angle, and the jet momentum coefficient. The dependence of the flow on $\alpha/_K$ and $C_J/_K{}^2$ is demonstrated. Author

N64-16940 Aeronautical Research Council (Gt. Brit.)
A NOTE ON THE THEORY OF PARACHUTE STABILITY
W. G. S. Lester London, HMSO, 1964 17 p refs
(ARC-R&M-3352) Available from HMSO: 6s 6d

A reassessment of a generally accepted theory of parachute stability has been made with the object of clarifying the assumptions used in its derivation and exposing deficiencies in previous treatments. Some new equations are derived, but lack of knowledge of the aerodynamic and apparent-mass coefficients prevents a comparison with experiment. The theory is idealized, and uncertainties with regard to the relation between the apparent-mass concepts in a real and an ideal fluid suggest that the correlation between theory and experiment may be slight. Experimental work on the apparent mass of a parachute is recommended in order to assess the validity of the theoretical model. Author

N64-16964 Naval Ordnance Test Station, China Lake, Calif. Underwater Ordnance Dept.
A LIFTING-SURFACE PROPELLER DESIGN METHOD FOR HIGH-SPEED COMPUTERS
D. M. Nelson Jan. 1964 52 p refs
(NAVWEPS-8442; NOTS-TP-3399; AD-430928)

A propeller design method that treats the blades as lifting surfaces has been developed and programed on an IBM 7090 computer. The singularity distributions representing the bound circulation, shed vorticity, and blade thickness are treated as continuous sheets, making it necessary to determine the Cauchy principal value of the improper integrals expressing the induced velocities on the blades. The camber lines and pitch angles are determined from the variation of the normal component of induced velocity across the blade. This method is applicable to moderately loaded, nonoptimum, wake-adapted propellers with or without skew. Author

N64-17121 Vehicle Research Corp., Pasadena, Calif.
A LIFTING SURFACE THEORY FOR WINGS AT HIGH ANGLES OF ATTACK EXTENDING THROUGH INCLINED JETS
T. Yao-Tsu Wu 21 Oct. 1963 17 p refs
(Contract Nonr-2388(00))
(VRC-9a; AD-426715)

Lifting Surface Theory for wings extending through propeller slipstreams based on the Rethorst Solution has been extended to encompass the effect of jets inclined to the free-stream flow. This extension permits the prediction of spanwise lift distribution and induced drag of tilt-wing and deflected slipstream V/STOL aircraft over the entire flight spectrum, from hovering to cruise. It is demonstrated that the effect of inclined jets on wing characteristics may be determined by applying appropriate boundary conditions (as derived in the present analysis) to the existing formulations enumerated above. The simplicity thus obtained results in a major reduction of numerical work and extends the usefulness of all phases of the program. Author

N64-17175 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MEASURING PRESSURE PULSATIONS AND DYNAMIC STRESSES ON ROTATING VANES OF AN AXIAL COMPRESSOR
G. S. Samoylovich and I. N. Pis'min *In its* Heat Power Eng. (Selected Articles) No. 8, 1962 2 Apr. 1963 p 12–20 refs (See N64-17173 09-01)

Studies are described of pressure pulsations and of the resulting dynamic stresses on axial compressor vanes. The investigations were conducted by the tensometric sounding method. The test condition at which the phenomenon of rotating flow separation takes place was investigated. R.T.K.

N64-17249 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
CALCULATION OF THE AERODYNAMIC CHARACTERISTICS OF WINGS OF FINITE SPAN NEAR THE GROUND [BERECHNUNG DER AERODYNAMISCHEN BEIWERTE VON TRAGFLUEGELN ENDLICHER SPANNWEITE IN BODENNAEHE]
Klaus Gersten London, Min. of Aviation, Dec. 1963 26 p refs Transl. into ENGLISH from Abhandl. der Braunschweig. Wiss. Ges. (Brunswick), v. 12, 1960 p 95–115
(RAE-Trans-1054)

The well-known methods for calculating the lift distribution on wings of finite aspect ratio in an unbounded flow field are extended for wings near the ground. The ground effect is taken into account by the reflection method. The vortex models used till now in the wing theories require a restriction to small angles-of-attack (linear theory). Approaching the ground, the lift increases for a constant angle-of-attack as well as for a constant flap angle; the induced drag, however, decreases at constant lift. The aerodynamic center is displaced backwards (stabilizing). By means of calculated examples the dependence of the ground effect on the height above ground, the aspect ratio, and the angle of sweep is determined. Author

N64-17337 General Dynamics/Convair, San Diego, Calif.
EXPERIMENTAL INVESTIGATIONS OF SUPERCAVITATING HYDROFOILS WITH FLAPS Technical Report
A. C. Conolly Dec. 1963 155 p refs
(Contract NObs-84615)
(GD/C-63-210; AD-432457) OTS: $11.50

This report presents smooth-water towing basin test data for two zero-dihedral supercavitating hydrofoils of aspect ratio 3.0, mounted by a single center strut and fitted with various sizes of split trailing-edge flaps. Measurements were made of hydrofoil and flap forces and moments over a wide coverage of parameters. The near-optimum flap size for a modified Tulin two-term foil giving maximum foil lift is shown to be flap chord equal to 3/10 of foil chord and flap span equal to 9/10 of foil span. Pressure mapping of the foil lower surface indicates that lower surface lift coefficients are essentially independent of speed, and that more than 50% of the foil lift comes from the upper surface for cavities that are only partially fed with atmospheric air. Author

N64-17338 General Dynamics/Convair, San Diego, Calif.
EXPERIMENTAL INVESTIGATIONS OF SUPERCAVITATING HYDROFOILS WITH FLAPS. APPENDIX A
A. C. Conolly Dec. 1963 260 p
(Contract NObs-84615)
(GD/C-63-210, Appendix A; AD-430895) OTS: $17.00

Basic experimental data (in tabular and graphical form) that resulted from the experimental investigations of supercavitating hydrofoils with flaps are presented. P.V.E.

N64-17485 Hydronautics, Inc., Laurel, Md.
LOW-DRAG BASE VENTED HYDROFOILS DESIGNED FOR OPERATION NEAR THE FREE SURFACE
Steven E. Starley and Virgil E. Johnson, Jr. Nov. 1963 60 p refs
(Contract NObs-84296)
(Tech. Rept. 001-15; AD-432976) OTS: $6.60

Linearized cavity flow theory is used to determine the shape and cavity drag of a series of low-cavity-drag base-vented hydrofoils having constant chordwise pressure distribution and operating at a particular depth–chord ratio. This family of base-vented hydrofoils is generated by perturbing a quasi-parabolic nonlifting thickness distribution so as to produce a base-vented lifting hydrofoil with a uniform loading. Numerical calculations are carried out to determine the shape, cavity-drag coefficient, section modulus, and lift-drag ratio for two-dimensional base-vented hydrofoils over a wide range of lift coefficients and incipient cavitation numbers at various depth–chord ratios. Families of zero cavity-drag base-vented foils are also presented for the same depth–chord ratios. Author

N64-17493* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EXPERIMENTAL INVESTIGATIONS ON SOLID SPOILERS AND JET SPOILERS AT MACH NUMBERS OF 0.6 TO 2.8
A. Heyser and F. Maurer 21 Feb. 1964 53 p refs Transl. into ENGLISH from Z. Flugwiss. (Brunswick, W. Germany), v. 10, no. 4, 5, 1962
(NASA Contract NAS7-100)
(NASA CR-53257; JPLAI-Trans. 32) OTS: $5.60 ph, $1.79 mf

Experimental investigations are reported regarding the effects of solid and jet spoilers on a flat plate in high-subsonic and supersonic tangential flow. The boundary layer of the plate is turbulent ahead of the separation at the spoiler. The height of the spoiler varies between 0.2 and 0.8 cm; the ratio of the stagnation pressure of the control jet and the static pressure in the test section varies between 3 and 60. The results of force and pressure distribution measurements are reported and discussed in relation to the flow pattern, and are compared with the measurements thus far available. The lift-drag ratio of the solid spoiler is compared with an analogic term of the jet spoiler. This term is shown to be in the order of magnitude of 2 in the supersonic range for the solid spoiler at the end of the plate, and may be considerably exceeded in the case of the jet spoiler. Author

N64-17741 Princeton U., N.J.
AERODYNAMIC CHARACTERISTICS OF HELICOPTER ROTORS. ROTOR CONTRIBUTIONS TO HELICOPTER STABILITY PARAMETERS
Edward Seckel and H. C. Curtiss, Jr. Dec. 1963 59 p refs
(Rept. 659)

Theoretical expressions are derived for the aerodynamic forces on a helicopter rotor, and for their contributions to various stability derivatives. The resulting expressions are tabulated, containing a number of functions of advance ratio that are presented graphically. Offset hinges and pitch-flap coupling are provided for in the formulation. A novel method for trim calculation is presented. The theory is based on the original results of Bailey. It involves some changes in notation, axes, assumptions, and the structure of formulas to widen their scope and improve their convenience for stability estimates. Discussion of the limiting assumptions is offered. Author

N64-17832* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A TABULATION OF HELICOPTER ROTOR-BLADE DIFFERENTIAL PRESSURES, STRESSES, AND MOTIONS AS MEASURED IN FLIGHT
James Scheiman Washington, NASA, Mar. 1964 693 p refs
(NASA TM X-952) OTS: $8.00

An extensive flight test program was conducted to obtain helicopter rotor-blade airloads, bending moments, and blade motions. In addition, numerous flight parameters were recorded. The tabulated data presented are for forward speeds

from 0 to 120 knots, flights in and out of ground effect, climbs, autorotations, maneuvers, and operations with forward and aft center-of-gravity locations. Basic helicopter characteristics and rotor-blade structural properties are presented. This report is a tabulation of the reduced rotor system data and the corresponding flight test conditions. The data are presented without analysis. Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-16949 Flying Personnel Research Committee (Gt. Brit.)
OSCILLATORY MOTION IN FLIGHT
G. Melvill Jones and D. H. Drazin (Inst. of Avi. Med., RAF) Air Ministry, Jul. 1961 21 p refs
(FPRC/1168)

Experiments were performed in a Javelin two-seater aircraft with a view to searching for parameters that define limits of aircrew tolerance. The aircraft was exposed to oscillatory conditions in roll and pitch at various frequencies and angular velocity amplitudes. Subjects assessed these conditions on a four-point scale of subjective tolerance ranging from entirely acceptable to entirely unacceptable, and their performance in a number of visual acuity tasks was assessed. The results suggested that, over the range of frequencies examined, maximum linear acceleration at the head proved the most significant criterion of tolerance, although it seems probable that, ideally, both this and the frequency of oscillation should be specified in order to establish reliable boundaries of acceptability. Despite reaching the subjective limits of tolerance, objective measurements of visual acuity showed no serious deterioration in the worst flight conditions. Author

N64-16952 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CZECHOSLOVAKIAN JET TRAINER L-29
Vaclav Nemecek 25 Jun. 1963 7 p Transl. into ENGLISH from Kridla Vlasti, no. 1, 1963, p 16–18
(FTD-TT-63-218/1; AD-413568)

The L-29 is the first jet aircraft of Czechoslovakian design and construction, and it is powered by the first jet engine of Czech construction. The history of the development of this aircraft and the details of its construction, as well as technical data relating to its design and performance, are included.
R.T.K.

N64-17014* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WALL EFFECTS AND SCALE EFFECTS IN V/STOL MODEL TESTING
Kalman J. Grunwald et al *In* Am. Inst. of Aeron. and Astronautics AIAA Aerodyn. Testing Conf. [1964] p 8–16 refs (See N64-17013 09-01) AIAA: $5.00 members, $10.00 nonmembers

The results of recent investigations to determine the wall effects on tilt-wing and buried-fan configurations indicate that significant wall effects can be encountered with both types. Heyson's wall correction theory was found to be adequate for correcting the lift and drag data of the two buried configurations investigated. For the tilt-wing configuration, Heyson's wall correction theory was adequate in correcting lift and drag to the free-air case only in the intermediate angle-of-attack ranges. At the low angles-of-attack the corrections were ineffectual in compensating for the wall effect, whereas at very high angles-of-attack and at very high drag conditions the drag correction was overestimated. Author

N64-17015* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TEST TECHNIQUES USED BY NASA FOR INVESTIGATING DYNAMIC STABILITY CHARACTERISTICS OF V/STOL MODELS
Lysle P. Parlett and Robert H. Kirby *In* Am. Inst. of Aeron. and Astronautics AIAA Aerodyn. Testing Conf. [1963] p 42–49 refs (See N64-17013 09-01) AIAA: $5.00 members, $10.00 nonmembers

Three model test techniques used by NASA in investigating the dynamic stability characteristics of V/STOL aircraft are discussed. These techniques are the free-flight technique, the control-line technique, and the forced-oscillation technique. Emphasis is primarily on the use of the techniques and the type of results that can be obtained by using them.
R.T.K.

N64-17256 Aeronautical Research Council (Gt. Brit.)
EQUILIBRIUM CONFIGURATIONS OF FLYING CABLES OF CAPTIVE BALLOONS, AND CABLE DERIVATIVES FOR STABILITY CALCULATIONS
S. Neumark London, HMSO, 1963 40 p refs
(ARC-R&M-3333; Supersedes RAE-AERO-2653, ARC-23244)
Available from HMSO: 16s

The theory of equilibrium of balloon flying cables is presented in a simplified form most suitable for applications, with numerical tables covering probably the full range of practical cases. A simplified derivation of formulas for longitudinal cable derivatives is presented, and the problem of the lateral cable derivative is solved. The normal oscillatory modes of the "balloon-plus-cable" system (longitudinal and lateral, ignoring balloon aerodynamics) are determined and analyzed. All final formulas are expanded into power series that converge well in the important case of a highly tensioned cable. The report provides the data necessary for studying dynamic stability of captive balloons. Author

N64-17279 Lockheed-California Co., Burbank
MODEL 186 HELICOPTER Progress Report No. 14, 1 Mar.–1 Apr. 1963
E. S. Cruz 5 Apr. 1963 15 p refs
(Contract NOw-62-0665-D)
(LAC-396358; LR-16778; AD-420037)

Continuing progress is being made into the flight test program. To date 71 flights have been made on two vehicles, accumulating 25 hr and 9 min of flight time. These flights have been made to a speed of 130 knots. Author

N64-17282 Princeton U., N.J. Instrumentation and Control Lab.
SOME DYNAMIC ASPECTS OF STABILITY IN LOW-SPEED FLYING MACHINES

Theodor A. Dukes, Jose M. Carballal, and Paul M. Lion Fort Eustis, Va., Army Transportation Res. Command, Nov. 1963 55 p refs
(Contract DA-44-177-TC-835)
(TRECOM TR-63-56; AD-431566) OTS: $5.60

This report is concerned with a linear time-varying approximation to the dynamics of low-speed flying machines. Simplifications and approximations are applied widely in order to emphasize essential aspects. The range of time variation is described in terms of frozen system loci of the roots corresponding to the predominant mode of a system. The rate of the time variation is described in terms of the deviation from the frozen system approximation. An analog computer study was made to specify quantitatively those rates of time variation that cannot be considered as slow. The longitudinal dynamics of VTOL aircraft is studied as an example in rather general terms. The results are used in a discussion of the following variable feedback configurations: direct feedback adjustments, adaptive feedback, and programed feedback adjustments. Author

N64-17451 Bell Aerosystems Co., Buffalo, N.Y.
STUDY OF FLEXIBLE JET EXTENSIONS FOR GROUND EFFECT MACHINES – PHASE II
J. B. Chaplin, T. D. Earl, B. Chiappinelli, and J. Kordenbrock Nov. 1963 87 p
(Contract Nonr-4175(00))
(Rept. 2131-920002; AD-428951)

This report presents the results of a test program of flexible jet extensions, or trunks, for Ground Effect Machines. A whirling arm test rig facility was provided to test model trunks under conditions simulating those of a full scale machine. The facility consisted of a self-powered whriling arm of 20-ft radius to which was attached a 4-foot diameter working GEM model. The annular jet GEM model provided for attachment of a full set of circular trunks 6 in. in height. Several obstacles, designed to produce effects on the trunks simulating full scale obstacles, were placed on the test track. Two sets of trunks of identical design but different materials were tested to destruction. Material differences were noted and design improvements suggested. Author

N64-17552 Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (W. Germany)
TRENDS IN HELICOPTER DEVELOPMENTS [ENTWICKLUNGSEICHTUNGEN IM HUBSCHRAUBERBAU]
Friedrich von Doblhoff Sep. 1963 38 p refs In GERMAN

A statistical representation of flight models flown during the period from helicopter inception up to the present time is given. Also, structural changes, various types of propulsion systems, performance, and economic evaluations are discussed. I.v.L.

N64-17654 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
PRESSURE MEASUREMENTS FOR MACH FIVE FLOWS OVER WINGED RE-ENTRY CONFIGURATIONS WITH AERODYNAMIC CONTROLS. PART II: CONICAL CABIN CONFIGURATION
Louis G. Kaufmann II Wright-Patterson AFB, Ohio, Res. and Technol. Div., Feb. 1964 210 p refs
(Contract AF 33(616)-8130)
(RTD-TDR-63-4179, Pt. 2; AD-433619)

Pressure data were obtained for Mach five flows over winged reentry configurations composed of cylindrical cabins mounted on a 60° sweepback delta wing with a cylindrical leading edge, clipped tips, and trailing-edge flaps. The model was tested with spherical and conical fronts on the cabin, with and without tip fins, and with and without a trailing-edge spoiler. Flap deflections were varied from −40° to +40° and the model was pitched at angles-of-attack from −30° to +45° for a free-stream Reynolds number, based on model length of 3,575,000. Author

N64-17725* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL FLUTTER STUDIES OF THE SWEPTBACK T-TAIL OF A LARGE MULTIJET CARGO AIRPLANE AT MACH NUMBERS TO 0.90
Charles L. Ruhlin, Maynard C. Sandford, and E. Carson Yates, Jr. Washington, NASA, Mar. 1964 61 p refs
(NASA TN D-2179) OTS: $1.50

A flutter investigation of the T-tail of a currently projected multijet cargo airplane has been conducted in the transonic dynamics tunnel at Mach numbers up to 0.90. The tail and aft fuselage of the model employed were geometrically, dynamically, and elastically scaled, whereas only the mass and stiffness characteristics of the forward fuselage, wings, and nacelles were simulated. This study included variations in flow density, stabilizer-pitch-actuator stiffness, fin-spar stiffness, roll and yaw stiffnesses of fin-stabilizer joint, rotational stiffnesses of elevators and rudder, stabilizer mass, and yaw and roll inertias. Author

N64-17726* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A FLIGHT INVESTIGATION OF THE PERFORMANCE, HANDLING QUALITIES, AND OPERATIONAL CHARACTERISTICS OF A DEFLECTED SLIPSTREAM STOL TRANSPORT AIRPLANE HAVING FOUR INTERCONNECTED PROPELLERS
Hervey C. Quigley, Robert C. Innis, and Curt A. Holzhauser Washington, NASA, Mar. 1964 62 p refs
(NASA TN D-2231) OTS: $1.50

A large four-engined aircraft having full-span triple-slotted, trailing-edge flaps and interconnected propellers was studied to gain further information on the flight and operational characteristics of typical STOL aircraft. The airplane investigated, the Breguet 941, had good STOL performance with the capability of making a landing approach with a glide slope of about 8° at an airspeed of less than 60 knots. The takeoff and landing distances over 35- and 50-ft obstacles, respectively, were less than 1,000 ft. The STOL handling qualities of the airplane were rated satisfactory except for longitudinal static stability and the lateral-directional static and dynamic stability that were rated acceptable: Because of a propeller interconnect feature the airplane was considered safe to fly at the low airspeeds required for STOL performance. Author

N64-17729* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW-SPEED FREE-FLIGHT STABILITY AND DRAG CHARACTERISTICS OF RADIALLY VENTED PARACHUTES
Sanger M. Burk, Jr. Washington, NASA, Mar. 1964 17 p refs
(NASA TN D-2271) OTS: $0.50

A drop-test investigation has been conducted to determine the stability and drag characteristics of radially vented (duplex) parachutes. Parachutes of two different designs were tested: a large parachute with high geometric porosity and a small parachute with low geometric porosity designed

for the same descent velocity with the same load. The results of the tests show that the large high-porosity duplex parachute was very stable in descent, oscillations averaging about ±3.4°; and the average drag coefficients based on the total canopy area and based on the fabric area alone were approximately 0.38 and 0.55, respectively. The small, low-porosity duplex parachute was also very stable in descent, oscillations averaging about ±4.5°; and the average drag coefficients based on the total canopy area and based on the fabric area alone were approximately 0.62 and 0.79, respectively. Author

N64-17748* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW-SPEED CHARACTERISTICS OF A 1/20-SCALE FOUR-ENGINE TRANSPORT MODEL WITH LARGE BODIES MOUNTED ABOVE THE FUSELAGE

Vernard E. Lockwood Washington, NASA, Mar. 1964 66 p refs

(NASA TN D-2205) OTS: $1.75

An investigation was made at a Mach number of 0.2 to determine the aerodynamic characteristics of a 1/20-scale model of a transport airplane having bodies with diameters greater than the fuselage mounted above the fuselage. The bodies represented were a Saturn first stage, a Saturn upper stage, and a capsule large enough to contain either stage. All bodies had nose and tail fairings The addition of bodies to the airplane model resulted in a large loss of directional stability. The airplane-capsule configuration required a vertical-tail area about 2 1/2 times the original area to provide satisfactory directional characteristics. Although the bodies had a detrimental effect on the longitudinal stability, the modifications to the vertical and horizontal tails that were necessary for directional stability resulted in the combinations having greater longitudinal stability than the basic model. The minimum drag of the airplane-body combinations were 50 to 70 percent greater than that of the original airplane configuration. Author

N64-17750* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TRANSITION CHARACTERISTICS OF A VTOL AIRCRAFT POWERED BY FOUR DUCTED TANDEM PROPELLERS

Edwin E. Davenport and Kenneth P. Spreemann Washington, NASA, Apr. 1964 58 p refs

(NASA TN D-2254) OTS: $1.50

Results are presented of a wind-tunnel investigation of the aerodynamic stability and control characteristics of a vertical takeoff and landing (VTOL) aircraft configuration powered by four tilting ducted propellers arranged in tandem pairs. The two front ducted propellers were mounted close inboard and near the top of the fuselage on the same level as the rear ducted propellers, which were mounted outboard on the tips of a short wing. The results indicate that the nose-up moment encountered in transition arises from two sources: the nose-up moment of the ducts themselves and the downwash at the rear element (pair of ducts and wing) that reduces the percentage of the lift produced by the rear element. Author

N64-17801 Hughes Tool Co., Culver City, Calif. Aircraft Div.

INVESTIGATION OF ADJUSTABLE TIP WEIGHTS FOR IMPROVEMENT OF HELICOPTER STABILITY THROUGH INCREASED DAMPING

R. J. Sullivan 28 Dec. 1963 104 p refs

(Contract NOw-62-0313-t)

(HTC-AD-63-16; AD-432624) OTS: $9.10

The desired rotor stabilizing forces would be produced by weights attached at the tips of the main rotor blades and located well forward of the 25% chord. For the controls-free case or the controls-fixed case for a helicopter equipped with a flexible control system, these stabilizing forces would cause properly phased cyclic pitch changes that would lead to added rotor damping. Increased damping in pitch was successfully demonstrated on the whirl test stand and was of the same order of magnitude as the predicted value. Preliminary endurance tests on the whirl stand indicated that the combined tension–torsion–chordwise bending loads introduced by the forward-located tip weights would require stiffening of the rotor blades. Whirl testing was successfully completed after a full-length rear spar was added to the blades being tested. The total rotor weight increment involved in the investigation was 1.3% of gross weight. The drag of a tip weight installation would cause a power-required increase amounting to about 1.2% of the cruise power of a standard helicopter. P.V.E.

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-17223* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

USERS' DESCRIPTION OF JPL EPHEMERIS TAPES

P. R. Peabody, J. F. Scott, and E. G. Orozco 2 Mar. 1964 29 p refs

(NASA Contract NAS7-100)

(NASA CR-53218; JPL-TR-32-580) OTS: $2.60 ph, $1.07 mf

A system for developing magnetic tape ephemerides of the moon and the planets has been established. Details pertinent to the distribution of these tapes and to their use in digital computer programs are given. In addition, the important features of the system relating to motivation, data acquisition and generation, ephemeris tape development, and procedures for assuring the accuracy of the data are described. Author

N64-17225* RAND Corp., Santa Monica, Calif.

ON GENERAL LEAST SQUARES ESTIMATION OF SOLAR SYSTEM CONSTANTS

R. T. Gabler and Albert Madansky Feb. 1964 54 p refs

(NASA Contract NASr-21)

(NASA CR-53195; RM-4019-NASA) OTS: $5.60 ph, $1.82 mf

This memorandum reviews the statistical theory of parameter and variance estimation and its application to the problem of estimating solar system constants. The usual statistical methods for treating experimental data are discussed, with particular attention to the concepts of random error and systematic error. The maximum-likelihood method for parameter estimation, which is a preferred statistical-estimation method, is shown to coincide with the general least-squares method when errors are distributed as the multivariate normal distribution. The general least-squares method is, therefore, of great potential utility; it is discussed in detail, especially with regard to methods for combining results from several related experiments. In the appendices, the theory is applied to several examples and to a specific experiment that has been suggested for determining the astronomical unit. Author

N64-17243 Joint Publications Research Service, Washington, D.C.
ASTRONOMICAL RESEARCH IN THE USSR
Gisela Barker 12 Mar. 1964 47 p refs Transl. into ENGLISH from Ost Europa Naturwiss. (Stuttgart), no. 1, 1963 p 16–43
(JPRS-23658; OTS-64-21780) OTS: $1.25

A historical survey of astronomical research in Russia from the 11th century to the present time is presented. The astronomical research organizations and observatories in the U.S.S.R. are discussed, and the astronomical publications available are listed. The international programs in which the U.S.S.R. participates are also presented. R.T.K.

N64-17331 Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE METEOROID HAZARD TO SPACE VEHICLES: AN ANNOTATED BIBLIOGRAPHY
Eugene E. Graziano and Helen B. Mc Cormick, comp. Aug. 1963 31 p refs
(Contract AF 04(647)-787)
(SB-63-58; Rept. 3-56-63-1; AD-431973)

This bibliography consists of 78 references to published materials on the meteoroid hazard to space vehicles in the near-earth environment. Author

N64-17350 Joint Publications Research Service, Washington, D.C.
STELLAR ASTRONOMY
Wlodzimierz Zonn and Konrad Rudnicki 24 Mar. 1964 577 p Transl. into ENGLISH of the book "Zvednaya Astronomiya" Moscow, Foreign Lit. Publishing House, 1959 p 1–448 Originally published in POLISH as "Astronomia Gwiazdowa" Warsaw, State Publishing House for Sci. Lit., 1957
(JPRS-23821; OTS-64-21869) OTS: $7.00

This book is intended primarily for students specializing in astronomy and astrophysics; however, it should be of interest to specialists in the fields of physical and mathematical sciences. In the beginning chapter, all of the most important general information on astronomy that is necessary for the comprehension of the subsequent chapters is included. In the subsequent chapters, problems relating to the spatial distribution of stars and interstellar matter and the kinematics of stars are discussed. A chapter is devoted to problems of evolution. This is followed by a discussion of the problems involved in the dynamics of stellar systems. The results obtained for the various problems are reviewed, and problems relating to present-day cosmogony are mentioned. The appendices cover: (1) a list of the most important textbooks and monographs on stellar astronomy; (2) the problem of n bodies; (3) gaussian distribution (normal distribution); (4) the correction of observed distributions for observational errors; (5) a solution of homogeneous linear differential equations of the first order in partial derivatives by the method of characteristic equations; (6) Dirac's δ-function; and (7) the determination of the distances of regions that irradiate a line $\lambda = 21$ cm. I.v.L.

N64-17518* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE STRUCTURE AND STRENGTH OF THE INNER PLANETS
Gordon J. F. Mac Donald Washington, NASA, Dec. 1963 86 p refs
(NASA TR R-173) OTS: $2.25

This report examines the internal structures of the Moon, Mars, Venus, and Mercury in the light of what is known about the internal constitution of the Earth. A review of the seismic determination of the elastic constitution of the Earth's mantle, based on new results on the stability of silicates at high pressures, leads to the interpretation that the rapid increase of elastic wave velocity beginning at a depth of 200 km depends on the olivine–spinel transition and the breakdown of silicates to oxides. The Earth's gravitational figure, as obtained from satellite orbits, is used to estimate the possible deviation from hydrostatic equilibrium in other planets. The Earth's response to tidal excitation provides information regarding the deviations of elasticity within the Earth. The near coincidence of the present rate of heat production of a chondritic Earth and the present surface heat flow is discussed as a limiting condition on the Earth's internal thermal structure. Author

N64-17561* General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
IMPLICATIONS OF SIMILARITY IN RARE-EARTH FRACTIONATION OF NAKHLITIC METEORITES AND TERRESTRIAL BASALTS
R. A. Schmitt and R. H. Smith Repr. from Nature (London), v. 199, no. 4893, 10 Aug. 1963 p 550–551 refs
(NASA Contract NASw-579)

Information is presented on the following: (1) the absolute and normalized abundances of the rare-earth elements scandium and yttrium in Nakhlitic achondrites, as determined by neutron activation; (2) the ratios of the average normalized weight percent of the rare-earth elements yttrium and scandium in Nakhla and Lafayette, to those in 16 chondrites, as a function of ionic radius; and (3) the ratios of the normalized weight percent of the rare-earth elements yttrium and scandium in 3 calcium-poor achondrites—Johnstown, Norton County, and Shalka—and in 3 calcium-rich achondrites—Nuevo Laredo, Pasamonte, and Juvinas—to those in 16 chondrites, as a function of ionic radius. R.T.K.

N64-17567* Esso Research and Engineering Co., Linden, N.J.
HYDROCARBONS IN TERRESTRIAL SAMPLES AND THE ORGUEIL METEORITE
Warren G. Meinschein Repr. from Space Sci. Rev. (Dordrecht), v. 2, 1963 p 653–679 refs
(NASA Contract NASw-508)

Meteorites contain extraterrestrial carbonaceous materials. The Alais, Orgueil, Tonk, and Ivuna meteorites resemble in their carbon, free sulfur, and nonmetamorphosed mineral contents, densities, and general appearances certain organic-rich terrestrial sediments. Structural and isotopic determinations of carbon compounds in the Orgueil chondrite indicate that these compounds are primarily indigenous. Physically and chemically, the benzene extractable carbonaceous materials from the Orgueil and certain near-surface terrestrial sediments are similar. Mass-spectrometric analyses of the alkanes from an Orgueil fragment, terrestrial sediments, and organisms are statistically indistinguishable at the 95-percent confidence level. Theoretical considerations and experimental data are presented, and these permit an assessment of the potential and reliability of hydrocarbons as biological indicators. Based on the production and preservation or organic substances in terrestrial environments, alkanes in the Alais, Orgueil, Tonk, and Ivuna (Type I) carbonaceous chondrites could retain the best evidence of organisms that may have lived on a parent body of meteorites. Author

N64-17592* Stanford U., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semi-Annual Status Report No. 2, 1 Jul-31 Dec. 1963

V. R. Eshleman Feb. 1964 9 p
(NASA Grant NsG-377)
(NASA CR-53205) OTS: $1.10 ph, $0.80 mf

Research conducted includes theoretical and experimental radio and radar studies of lunar and planetary ionospheres, atmospheres, and surfaces, and radar studies of the sun and interplanetary medium. R.T.K.

N64-17609* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REVIEW OF DIRECT MEASUREMENTS OF INTERPLANETARY DUST FROM SATELLITES AND PROBES
W. M. Alexander, C. W. Mc Cracken, L. Secretan, and O. E. Berg Presented at the COSPAR Meeting May 1962 Submitted for Publication (Previously published as N63-17107 15-23)
(NASA TM X-54570; X-613-62-25) OTS: $4.60 ph, $1.58 mf

The results of direct measurements from various penetration and fracture experiments are presented. Two satellite experiments, Vanguard III (1959 Eta) and Explorer I (1958 α), give evidence for dust particle streams. Vanguard III measured 2,800 events in a 70-hr interval coincident with the Leonid meteor shower. For a 10-hr period, Explorer I detected an interplanetary dust stream with impact rates as high as 25 times the average impact rate during the satellite's lifetime. The distribution curve obtained with the direct measurements differs from that expected from extrapolations of meteor observations. The small dust particles dominate the accretion by the earth of interplanetary matter; the accretion rate is of the order of 10^4 tons per day. Author

N64-17657 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ON THE ORIGIN OF THE PLANETARY SYSTEM
C. F. von Weizsacker 25 Feb. 1964 39 p refs Transl. into ENGLISH by JPRS from Z. Astrophys., (Heidelberg), v. 22, 1944 p 319–355
(RSIC-138; AD-432290)

It is assumed that the planets originated from a strongly flattened gas envelope that rotated around the sun and whose weight consisted, like the sun itself, of only about one percent of the heavy elements that constitute the earth. Such a gas envelope had to be formed when the sun first came into being and had then to dissipate within 10^7 to 10^8 years due to its turbulent internal movements. Systems of convection currents had to develop within this gas envelope, that showed a preference for certain locations suitable for the generation of planets and thus created a sequence of planet distances from the sun according to the Titus–Bode rule. The planets were formed through the conglomeration of small lumps of condensed heavy elements. The moons originated in the same manner, in smaller gas envelopes that formed around the planets. Author

N64-17711* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ORIGIN OF TEKTITES – A REVIEW
Paul D. Lowman, Jr. Repr. from School Sci. Math., Jan. 1964 p 37–46 refs
(NASA RP-150)

This paper summarizes the history of the tektite study and the present status of the problem. It also discusses some of the more subjective aspects of the intense controversy that has surrounded the tektite study. An attempt is made to explain exactly what tektites are, and the average chemical composition by weight is given. A description is then given of the location and type of strata in which tektites are found. The discussion covers various theories of the origin of tektites. C.L.W.

N64-17793* Florida State U., Tallahassee
Semi-Annual Status Report, Aug. 1, 1963–Jan. 31, 1964 [STATISTICAL INVESTIGATION OF THE CORRELATION BETWEEN JUPITER ACTIVITY AND SOLAR ACTIVITY]
C. H. Barrow [1964] 19 p refs
(NASA Grant NsG-224-61)
(NASA CR-53301) OTS: $1.60 ph, $0.80 mf

A series of observations of the polarization of radiation from Jupiter have been made at frequencies of 16, 18, 22, and 26 mc. In general, for the period of the observations, almost all of the radiation at 22 and 26 mc was right-handed polarized (R.H.), whereas at 16 and 18 mc an appreciable proportion of bursts were L.H. In particular, events observed when $300 < \lambda_{III} \leq 360$ (I.A.U. revised System III) were found to contain, respectively, 41% and 30% L.H. bursts at 16 and 18 mc. A series of spaced-site observations from three sites have been completed and analysis is in progress. Author

N64-17826* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DISCUSSION OF HALPHEN'S METHOD FOR SECULAR PERTURBATIONS AND ITS APPLICATION TO THE DETERMINATION OF LONG RANGE EFFECTS IN THE MOTIONS OF CELESTIAL BODIES, PART I
Peter Musen Washington, NASA, Dec. 1963 56 p refs
(NASA TR R-176) OTS: $1.50

It is shown that Halphen's method of treating secular planetary effects can, by means of step-by-step integration, also be used to determine long-range lunar effects in the motions of artificial satellites. It permits the numerical integration of long-range lunar effects over interval of a few tens of years. The long-range solar effects can be treated by averaging the disturbing function over the orbit of the satellite. Halphen's method is applicable to the determination of long-range (secular) effects in the motion of minor planets over the interval of hundreds of thousands of years. It is assumed that no sharp commensurability between mean motions of the disturbed and disturbing bodies exists. Author

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-16953 Smith (A. O.) Corp., Milwaukee, Wis. Long Range Research Lab.
NOVEL POWER SOURCES FOR SHELTERS
Francis W. Lauck and Vern D. Overbye Mar. 1963 149 p refs
(Contract OCD-OS-62-243)
(AD-431610)

The purpose of this study is to examine systems utilizing various energy-conversion devices for the generation of power in order to determine advantages and disadvantages of these systems. Internal-combustion engines, coupled with generators or alternators, are currently the most promising methods for generating low power (up to 5 KW) in a shelter. The state of the art is such that, with certain restrictions on storage and

operating techniques, they could be "stored" for a 10-year period and then produce the desired quantity of power. A summary of the findings in the study of other chemical-to-electrical energy-conversion devices and accessory equipment is given. Author

N64-16955 Little (Arthur D.), Inc., Cambridge, Mass.
METHODS FOR LOW POWER TEMPERATURE CONTROL First Quarterly Report, 1 May-31 Jul. 1963
Igor A. Black and John Peterson [1963] 38 p
(Contract DA-36-039-AMC-02207(E))
(AD-431543)

This report describes work done in an investigation of methods, techniques, and devices by which the temperature of a quartz crystal can be maintained, with a minimum of power, at a nominal operating temperature over environmental temperature extremes. The work includes investigations of second-order effects applicable to the design of low-power crystal ovens. End products resulting from the study are three types of ovens: a 3-cubic-inch, 500-milliwatt oven (Type J6) requiring accessibility to the crystal and operating at +75° C ±1° C over a −55° C to +60° C ambient; a 3-cubic-inch, reduced power, sealed oven (Type K6G) with similar operating requirements; and a 4-cubic-inch, 250-milliwatt oven (Type L6) requiring accessibility to a chamber capable of housing 2 crystals and operating at 0° C ±1° C over a −55° C to 0° C ambient. Author

N64-17115 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
SOLID-STATE PANEL DISPLAY Technical Report, 1 Jun.-30 Nov. 1963
Stephen Yando Wright-Patterson AFB, Ohio, AF Avionics Lab. Dec. 1963 24 p refs
(Contract AF 33(657)-11371)
(RTD-TDR-63-4294; Rept. 63-209.7; AD-431822)

Three developments for improved brightness and contrast are a multiple-electrode input transducer design that imparts a higher voltage to the piezoelectric sheet, a nonlinear resistor layer that suppresses unwanted excitation, and a coupling film that permits the use of the nonlinear resistor layer without affecting elastic-wave propagation in the ceramic sheet. A new ferroelectric amplifier has been devised that promises piezoelectric-electroluminescent displays of still higher brightness, resolution, and efficiency. A description of the circuit and its initial performance is given. The development of techniques for forming arrays of the circuit elements has begun. Author

N64-17118 Arizona U., Tucson Lab. for the Study of Sensory Systems
STUDY AND DEVELOPMENT OF MUSCLE SUBSTITUTES Final Report, 1 Sep. 1962-31 Aug. 1963
Howard A. Baldwin, John V. Wait, Ronald L. Brown, and Clarence W. Wieske Wright-Patterson AFB, Ohio, Res. and Technol. Div., Jan. 1964 84 p refs
(Contract AF 33(657)-8875)
(RTD-TDR-63-4181; AD-431825)

A two-phase membrane forms the basic element of a device whose operation may be described by the same mechanical analog that describes skeletal muscle. The contractive device utilizes low-pressure air to lift a weight or to move an eccentric shaft of a rotary force transducer (muscle engine). A mathematical model of the contractive device is developed, and methods of control of the unit are discussed. The "fluid amplifier"/"sphincter valve" device demonstrates an analogy to the sphincter action of muscles. When it is incorporated into a hydraulic system, it has characteristics similar to the electronic vacuum-tube amplifier. The preliminary quiescent and dynamic characteristics of this device are presented. Author

N64-17163* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
THERMAL AND THERMIONIC CHARACTERISTICS OF A LARGE-SCALE EXPERIMENTAL THERMIONIC CONVERTER
A. Vary Washington, NASA, Mar. 1964 38 p refs
(NASA TR R-192) OTS: $1.00

A thermionic energy converter based on a coaxial diode configuration was used to obtain information relative to problems associated with instrumenting and heating a large-scale converter and to determine certain thermal and thermionic characteristics. The cylindrical tungsten cathode, having an emitting area of 73.7 cm^2, was operated at temperatures in the range 1,200° to 2,000° K. Diode thermal characteristics, such as temperature gradients, temperature ratios, heat-flow distributions, and thermal emissivities, were studied. Thermionic characteristics were determined in both a vacuum and a cesium-vapor atmosphere. The investigation defined problems associated with thermal gradients on emitting areas, interelectrode resistive leakage caused by vapor deposition, determination of heat-transfer properties, and measurement of cathode emission properties. Author

N64-17205* Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.
PARALLEL INVERTER AND CONVERTER OPERATION AND IMPROVEMENTS IN TRANSFORMERS First Quarterly Report, 28 Jun.-27 Sep. 1963
G. W. Ernsberger, J. L. Klingenberger, and H. R. Howell [1963] 95 p refs
(NASA Contract NAS3-2792)
(NASA CR-53206) OTS: $8.60 ph, $3.05 mf

The output transformer design was completed and is described. Cubex steel has a lower core loss for high flux densities (12 to 20kg) than do nonoriented silicon steel materials. The use of Cubex core materials should increase the efficiency of the inverter/converter used in the paralleling task. The necessary conditions for satisfactory paralleling of static inverters and converters were considered mathematically to determine circuit design criteria. Methods of paralleling were chosen, and circuits were designed for applying these methods to an existing high-performance static inverter/converter design. Author

N64-17220 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio
SNAP 2 POWER CONVERSION SYSTEM. ROTATIONAL SPEED CONTROL Topical Report No. 18 [1 Mar. 1960-1 Jul. 1961]
W. E. Dauterman and E. J. Viton Dec. 1963 36 p Prepared under subcontract with Atomics International
(ER-5075; NAA-SR-6310) Available from AEC: $0.75

The parasitic load speed control for the SNAP 2 power conversion system consists of a frequency-discriminator low-level magnetic amplifier, magnetic amplifier power stages, and a resistive load. Design and development have progressed to the point where experimental results have confirmed the present breadboard design approach. Frequency is controlled within ±1%, and all functional control specifications of the SNAP 2 system have been met. High-temperature component testing has shown that basic components are available for operation at elevated temperature (350° C) in most areas. Author

N64-17283 Yardney Electric Corp., New York, N.Y.
DEVELOPMENT OF THE SEALED ZINC-SILVER OXIDE SECONDARY BATTERY SYSTEM First Quarterly Progress Report, 1 Jul.-30 Sep. 1963
Martin Sulkes et al [1963] 60 p refs
(Contract DA-36-039-AMC-02238(E))
(AD-432195)

Sixteen sealed Zn-AgO cells were built and have completed formation cycles. Tests have been run on sealed Zn-AgO cells to determine pressure increase during discharged stand. It was found that an externally shorted cell would develop 40 to 50 psig after 3-days stand at RT. Capacity maintenance and pressure buildup on charged stand at 160°F were determined and found to be within acceptable limits. Author

N64-17305 Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
HYDROGEN-OXYGEN CAPILLARY TYPE FUEL CELL Fourth Quarterly Technical Progress Report [1 Feb.-30 Apr. 1963]
N. P. Bonnerton et al 15 May 1963 97 p
(Contract AF 33(657)-8970)
(AD-404661)

Five units of the Orbital Package have been constructed. A preliminary engineering evaluation vibration test was carried out early in February, and satisfactory shock and acceleration tests were conducted in April. The motion tests were conducted with the fuel cell passive. From the test data obtained throughout this quarter, the following conclusions are drawn: (1) The fuel cell package has performed satisfactorily during prior and post environmental tests. Shock and acceleration testing did not affect the electrical performance of the fuel cell. (2) The evaporative cooling system has operated satisfactorily throughout the testing. (3) All thermostats performed as required, and switching of the electrical output from external load resistors to internal heaters was accomplished during package testing. Author

N64-17376 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.
PROCEEDINGS, 17TH ANNUAL POWER SOURCES CONFERENCE
Red Bank, N.J., PSC Publ. Comm. [1963] 196 p refs Conf. held at Atlantic City, 21-23 May 1963

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N64-17377 Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.

SILICON CELLS FOR USE IN CONCENTRATED SOLAR ENERGY

E. L. Ralph and P. Berman *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 1–4 refs (See N64-17376 09-06)

(Sponsored by Army)

The optimum design of a solar cell to perform in a terrestrial environment at solar illumination intensities of 1 to 5 Langleys is discussed. Since series resistance is the most important design parameter in this case, the resistances of an equivalent circuit for a 5-grid cell are examined theoretically. The total series resistance expected is found to be 0.38 ohms for P/N cells and 0.73 ohms for N/P cells. The optimum spacing of the grids when more than 5 grids are required is also discussed; at solar intensities of about 5 Langleys, the optimum spacing was found to be about 0.216 cm (9 grids on 1 × 2 cm cell) for P/N cells, and 0.184 cm (11 grids on 1 × 2 cm cell) for N/P cells. These results were confirmed experimentally, using a statistical polyvariable approach in which the parameters having the greatest influence on cell series resistance and spectral response were considered. A consideration of cost factors shows that the use of concentrators with solar cells should give cost advantages, and a further cost advantage is anticipated if polycrystalline silicon material could be used instead of the single-crystal material presently required.

M.P.G.

N64-17378 Westinghouse Electric Corp., Youngwood, Pa.

LARGE AREA SOLAR CELLS PREPARED ON SILICON SHEET

R. K. Riel and K. S. Tarneja *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 5–8 (See N64-17376 09-06)

(Sponsored by AF)

The successful fabrication of large area solar cells from silicon sheets is reported. The manufacturing techniques involved in fabricating solar cells 0.9 cm × 30 cm × 0.05 cm, with efficiencies as high as 10%, are discussed. Using aluminum-honeycomb structure substrate, solar-cell panels 13 in. × 6.7 in. × 0.060 in., consisting of 12 solar cells, have been fabricated and satisfactorily tested in vibration, mechanical-shock, acceleration, white-noise, and thermal-shock environments. M.P.G.

N64-17379 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.

SOLAR POWER SUPPLIES FOR GROUND USE

George Hunrath *In its* Proc., 17th Ann. Power Sources Conf. [1963] p 8–11 refs (See N64-17376 09-06)

Possible designs and applications for ground-based, solar, photovoltaic energy converters are discussed. An experimental modular, expansible type of solar-energy converter, in which the individual solar-cell modules can be rearranged, added, or

subtracted, is described. This converter is coupled with a solar sensor and orienting system that can maintain the array normal to the sun, within a few degrees, over a period of 30 days. The electrical-power output of this converter is dependent upon the amount of solar energy incident on the earth's surface, but recently published data indicate that, in many areas of the globe, sufficient electrical power can be generated for applications such as locator beacons, weather stations, charging batteries, and emergency power supplies. Other devices being developed incorporate solar concentrators with the solar cells. A manually operated, portable, solar, photovoltaic energy converter, producing a maximum power output of 25 watts, is also described. M.P.G.

N64-17380* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR ENERGY SYSTEMS FOR SPACE APPLICATION
William R. Cherry *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 12–15 refs (See N64-17376 09-06)

The factors influencing the design of solar-energy systems for space application are discussed. These factors include the orbit of the satellite, the range of power requirements, the anticipated lifetime, the type of stabilization (spin-stabilized or solar-oriented), and restrictions imposed by size, weight, and effect on scientific instrumentation. The power developed by various types of arrays is discussed, and the power-system characteristics of some recent satellites are tabulated. Damage to solar cells by dust particles, radiation, and other space hazards is discussed, and means of providing protection for the solar array are considered. The future of solar-cell power systems and the areas where improvements are most needed are outlined. M.P.G.

N64-17381 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
SOME EFFECTS OF ELECTRON IRRADIATION AND TEMPERATURE ON SOLAR CELL PERFORMANCE
J. H. Martin, J. W. Teener, and E. L. Ralph (Textron Electron.) *In* Army Signal Res. and Develop. Lab. Proc. 17th Ann. Power Sources Conf. [1963] p 15–19 refs (See N64-17376 09-06)

The results of theoretical analysis and experimental studies of solar-cell performance after irradiation and as a function of temperature are presented. Calculations of minority carrier lifetimes, the short-circuit current, and voltage effects on both P/N and N/P cells before and after irradiation are developed. Experimental results of short-circuit current, open-circuit voltage, and maximum power as a function of temperature for increasing levels of 1-Mev electron flux are presented graphically for nominal 10Ω-cm N/P and nominal 1Ω-cm P/N cells. The temperature coefficient of short-circuit current was found to increase with irradiation while the temperature coefficient of open-circuit voltage remains constant over the range of irradiation investigated. Preliminary results of solar-cell degradation experiments on the ANNA 1B geodetic satellite are also discussed. M.P.G.

N64-17382* Naval Research Lab., Washington, D.C.
EFFECTS OF RADIATION ON TRANSMITTANCE OF GLASSES AND ADHESIVES
F. J. Campbell *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 19–22 (See N64-17376 09-06)
(Sponsored by NASA)

The electrons and protons of the space radiation belts, as well as the ultraviolet energy of the sun in space, will degrade the optical transmittance characteristics of glasses and adhesives, which are used to cover solar cells, some being affected much more than others. This degradation reduces the sun energy reaching the solar cell so that it must also be calculated into the decrease in power from a solar array exposed to radiation. Author

N64-17383 General Motors Corp., Santa Barbara, Calif.
THERMO-PHOTOVOLTAIC ENERGY CONVERSION
John Werth *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 23–27 refs (See N64-17376 09-06)

Selective reflection as a method of matching germanium cells to a gray body radiator operating at a surface temperature of 1,400° C or less, has a potential relative spectral efficiency of about 70%. At power output densities of the order of 0.5 to 1 w/cm^2, presently fabricable germanium cells have a potential conversion efficiency of about 35% for monochromatic radiation. For gray body radiation, therefore, the potential cell conversion efficiency is about 25%. Author

N64-17384 Battelle Memorial Inst., Columbus, Ohio
MULTI-SOLID FUEL BURNER FOR THERMAL ENERGY CONVERSION SYSTEMS
Herbert R. Hazard *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 28–30 (See N64-17376 09-06)

Efforts to develop a multisolid fuel burner for incorporation in a thermal-energy-conversion system that would produce 150 watts of power, be portable, simple to operate and maintain, and reasonably efficient are described. Technical considerations include the burning rates of the locally available solid fuels (wood, charcoal, coke, coal, animal dung, and grains), the type of combustion residue, the size of the fuel pieces, and the combustion airflow rate. Three experimental burners are described: (1) a gravity-fed burner, with a high combustion efficiency but with poor transfer of the fuel heating value to the energy-conversion unit; (2) a compact burner, in which the heat losses were limited by reducing the surface area, but which required continuous feeding of carefully prepared fuel, and was no more efficient than the larger burner; and (3) a burner enclosed in an energy-conversion unit, which exhibited a high (60% to 74%) thermal efficiency, and will be investigated further. Auxiliary power is required by these burners to move the combustion air through the system, thus making an overall energy-conversion efficiency of about 3% probable. These burners are well suited for use with thermoelectric generators, steam-cycle engines, or air-cycle engines. M.P.G.

N64-17385 General Instrument Corp., Newark, N.J.
45-WATT THERMOELECTRIC GENERATOR
Charles Teleki *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 31–33 (See N64-17376 09-06)

The design and development of a lightweight (12 lbs.), compact, rugged, 45-watt thermoelectric generator that operates on leaded-gasoline fuel are described. The generator consists of three major subsystems: (1) the burner and fuel-control system; (2) the process air-handling system; and (3) the thermoelectric modules. The operation of each of these systems and their integrated performance is discussed. M.P.G.

N64-17386 Radio Corp. of America, Harrison, N. J.
SILICON-GERMANIUM THERMOCOUPLE DEVELOPMENT
Valvo Raag *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 34–37 ref (See N64-17376 09-06)

The silicon–germanium alloys and their applications as thermocouples are discussed. These alloys have a high figure of merit, possess excellent electrical and mechanical stability over a large temperature range, and can be operated unprotected in air or vacuum. Representative thermoelectric properties of these alloys are discussed. A 50-watt air-operated, silicon–germanium alloy thermoelectric generator that has exhibited negligible deterioration in prolonged operation is given as an example of the application of these alloys. M.P.G.

N64-17387 Thermo Electron Engineering Corp., Waltham, Mass.
45-WATT THERMIONIC GENERATOR
F. J. Lyczko *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 37–40 (See N64-17376 09-06)

Efforts to develop a silent, lightweight, 45-watt, 6-volt thermionic generator heated by the combustion of leaded gasoline and air are described. The initial test engine design, diode and emitter shell development, and burner performance studies are discussed. The results of these components studies have been incorporated in the design of an experimental engine with the following features: lightweight structure, vapor-lock-proof fuel metering system, exhaust-gas-heated fuel vaporizer, improved fuel injection, lightweight heat exchanger, and high-performance diodes with improved pyrolytically deposited silicon carbide emitter shells. M.P.G.

N64-17388 Ford Instrument Co., Long Island City, N.Y.
LOW TEMPERATURE THERMIONIC CONVERTER
M. Silverberg *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 40–43 (See N64-17376 09-06)

The basic advantages of a thermionic converter based on the use of dispenser emitters are discussed; these include low operating temperature and low cesium pressure. This combination permits the use of a wide range of fabrication materials, as well as wide spacing, which permits a reduction in manufacturing tolerances and greatly improves reliability. A special characteristic of this type of converter is that it can deliver a.c. power directly, which will be advantageous in the design and construction of a practical fossil-fired thermionic power converter. M.P.G.

N64-17389 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.
AC THERMIONIC CONVERTER STUDY
Joseph P. Angello and Emil Kittl *In its* Proc., 17th Ann. Power Sources Conf. [1963] p 43–47 refs (See N64-17376 09-06)

A single thermionic diode power source appears more promising at this time than a multidiode system. At the present state-of-the-art, the cost of a thermionic diode is high and the cost to build a single large diode would only be slightly higher than the cost to build a small one. Theoretically, under ideal conditions, the overall efficiency of the unsymmetrical waveform generator appears to be higher than the series connected diode system. Author

N64-17390 North American Aviation, Inc., Columbus, Ohio
INTERNALLY HEATED THERMIONIC CONVERTER SYSTEM
W. R. Martini *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 48–52 refs (See N64-17376 09-06)
(Contract DA-36-039-SC-88982)

Design considerations for internally heated thermionic converter systems which would have higher power-to-weight ratios than batteries and operate silently on a ubiquitous fuel, such as gasoline, are discussed. Improvements that are being made on the first operative high-temperature, cesiated, flame-heated thermionic converter are considered, with special emphasis on the development of an adequate hot shell to protect the molybdenum refractory metal emitter material from oxidation and from excessive hot combustion gas permeation. The design of a small, vacuum-insulated diode heater that uses a fuel injection system and that has attained a temperature of 1,350° C on the emitter surface, with a heating efficiency of about 12% and a heat flux of about 22 watt/cm^2, is presented. The incorporation of two of these diode-heater modules into a complete power generation system is discussed. M.P.G.

N64-17391 Electric Autolite Co., Conshohocken, Pa.
BIOCHEMICAL FUEL CELLS, PART 1
Manuel Shaw *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 53–56 (See N64-17376 09-06)

A general survey of the basic principles involved in the development of biofuel cells is presented. The discussion includes biological oxidation, classification of biofuel cells, basic types of biochemical fuel cells, bioelectrodes, electrochemical metabolism, and microbial growth and electrode potential. The electrochemical and microbiological problems associated with biochemical fuel cell development are also reviewed. M.P.G.

N64-17392 Magna Corp., Anaheim, Calif.
BIOCHEMICAL FUEL CELLS, PART 2
J. Brake, W. Momyer, J. Cavallo, and H. Silverman *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 56–59 refs (See N64-17376 09-06)
(Sponsored by Army)

A preliminary report on the problem of using urea at the anode of a biofuel cell is presented. The results of independent studies of the biochemical reaction in which a biological agent is used as a catalyst to convert urea to ammonia and carbon dioxide, and of the subsequent ammonia electro-oxidation reaction, were used to select the optimum range of conditions under which both reactions would proceed. The performance of a *Bacillus pasteurii*–urea electrode was compared to the performance of urea without *Bacillus pasteurii*; the addition of *Bacillus pasteurii* to urea was found to shift the open-circuit potential of the system −0.4 volts and to increase the limiting current density approximately tenfold. The achievement of higher current densities in biofuel cells is considered to be dependent upon defining the rate-limiting step and increasing the rate density. M.P.G.

N64-17393 Melpar Inc., Falls Church, Va.
BIOCHEMICAL FUEL CELLS, PART 3
G. C. Blanchard, R. T. Foley, and M. J. Allen *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 59–64 refs (See N64-17376 09-06)
(Contract DA-36-039-SC-90878)

Three biochemical processes are being investigated with emphasis on determining their contribution to energy-conversion

systems, rather than on building highly efficient fuel-cell systems: (1) the generation of hydrogen by microorganisms for immediate or subsequent usage at gas electrodes; (2) the electrochemical characteristics of certain electrochemical cells using *Escherichia coli*; (3) the increase in potential observed in the glucose–glucose oxidase reaction system with the addition of iron. M.P.G.

N64-17394 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.
PROGRESS ON OXYGEN ELECTRODES
James E. Wynn *In its* Proc., 17th Ann. Power Sources Conf. [1963] p 65–69 refs (See N64-17376 09-06)

Results of studies of the oxygen electrode reaction on electrodes of catalyzed and noncatalyzed carbon, as well as various metals in acid electrolyte, are reported. The following processes were investigated because of the possibility that they might be rate-limiting reactions: (1) mass transport of oxygen gas to reaction sites; (2) adsorption of the gas; (3) electrochemical reduction of the active oxygen species at the electrode; and (4) desorption of the reaction product. The results of these studies are being applied to the selection of proper electrode materials, structures, and designs for efficient oxygen electrodes for acid media fuel cells. M.P.G.

N64-17395 General Electric Co., Schenectady, N.Y.
LOW TEMPERATURE C_3 HYDROCARBON CELLS
W. T. Grubb and L. W. Niedrach *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 69–72 refs (See N64-17376 09-06)
(Sponsored by ARPA)

At 89°C cyclopropane and propylene produced current densities in excess of 80 ma/cm^2 using platinum catalyzed electrodes and 3 molar sulfuric acid electrolyte. Under these conditions propane still entered a region of collapsing performance at about 10 ma/cm^2. At the same temperature, a comparison of sulfuric, phosphoric, and perchloric acids showed that the anion effect is small. Sulfuric acid was found unsuitable above 100° C because of direct oxidation of hydrocarbon fuels by the electrolyte and formation of platinum catalyst poisons. At 150°C 14.6 molar phosphoric acid was a very effective electrolyte, and propane supported current densities in excess of 100 ma/cm^2 in this system, using platinum catalyzed electrodes; propane oxidized completely within experimental error at several operating points, e.g., 20 ma/cm^2 at 0.48 volts (iR loss included). It is concluded that propane may be a practical direct fuel for fuel cells between 100° and 200° C. Author

N64-17396 Institute of Gas Tech., Chicago, Ill.
NEW CONCEPTS ON HIGH TEMPERATURE HYDROCARBON CELLS
L. G. Marianowski, John Meek, E. B. Shultz, Jr., and B. S. Baker *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 72–75 refs (See N64-17376 09-06)
(Sponsored by the Am. Gas Assoc.)

The following significant achievements in the high-temperature fuel cell area have been demonstrated: (1) continued and stable operation for over 4000 hours; (2) scaleup from small single cells to larger dimensions without loss in power per unit area; (3) multiple-cell battery construction; (4) recirculation of anodic carbon dioxide; (5) natural convection cathodes of open design; and (6) integration of a hydrocarbon reformer and fuel cell units. Author

N64-17397 Englehard Industries, Inc., East Newark, N. J.
COMPACT H_2 GENERATORS FOR FUEL CELLS
H. H. Geissler *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 75–77 refs (See N64-17376 09-06)

A portable 107-liter-per-hour hydrogen generator to supply a 200-watt hydrogen–oxygen fuel cell power package is described. This miniaturized device catalytically dissociates ammonia to yield nitrogen and hydrogen. The hydrogen gas is separated by diffusion elements of palladium–silver alloy, and the residual gas is used as fuel to supply the total energy requirements, including heat losses, of the process. The components of the generator are described schematically, and calculations that show that about 60% of the gross heating value can be recovered are discussed. The same basic process considerations can be applied to hydrogen generators operating on methanol or other selected hydrocarbon fuels. M.P.G.

N64-17398 Daniel (Cuthbert), New York, N.Y.
EXPERIMENTAL DESIGN FOR FUEL CELL RESEARCH
Cuthbert Daniel *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 78–79 ref (See N64-17376 09-06)

The advantages of using statistical methods to lay out experimental work so that each run or test yields as much information as possible are demonstrated. The fact is stressed that statisticians are not attempting to tell experimenters what factors to vary, what level of the factors to vary, or what systems to study. Rather, the use of statistics in planning complex experiments, such as those required in fuel cell research, would indicate the existence of nonadditives (interactions) if they are large, and be of maximum sensitivity in detecting the average effects of factors if there are no interactions. M.P.G.

N64-17399 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.
LOW POWER GROUND APPLICATIONS
Herbert F. Hunger *In its* Proc., 17th Ann. Power Sources Conf. [1963] p 80–82 ref (See N64-17376 09-06)

The need for developing fuel cells for low power (10 w up to several kilowatts) ground applications to bridge the gap between conventional batteries and engine generators is discussed. Cost vs mission time analyses show that after about 100 h the fuel cell battery cost is lower than that of the cheapest military battery. Engine generators are shown to be inefficient in missions requiring low power levels and have the additional disadvantages of increased weight and noise levels. Three typical missions for which portable, lightweight fuel cell power supplies are being developed are discussed; the advantages of fuel cells for these missions include low weight of the power source or high watt hour/lb ratio for packaged power for extended missions, adequate volume characteristics, low cost, an expected operating life in the order of several thousand hours, low audio- and thermo-detectability, and relatively high operating efficiency. M.P.G.

N64-17400 Army Engineer Research and Development Labs., Fort Belvoir, Va
HIGH POWER GROUND APPLICATIONS
B. C. Almaula *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 82–84 (See N64-17376 09-06)

The future of fuel cells and nuclear-fuel cell systems that operate on petroleum fuels with air as the oxidant is discussed, with emphasis on high-power, ground-based military applications. The end uses of the energy derived from fuel cells are

considered to be (1) a self-contained portable and semiportable a.c. and d.c. electric power supply, and (2) a power source to propel vehicles. The present status of fuel cell development is the laboratory demonstration of electrochemical oxidation of hydrocarbons at 50% efficiency. A program to develop a compact, reliable, and efficient power source based on this principle is outlined. The advantages and disadvantages of nuclear reactor–fuel cell combinations as energy depots are also discussed. M.P.G.

N64-17401 Air Force Dept., Washington, D.C.
FUEL CELLS IN AEROSPACE
Gerald E. Starkey *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 84–85 ref (See N64-17376 09-06)

Space missions for which primary (hydrogen–oxygen) fuel cells appear to be the optimum energy conversion method are surveyed. The criteria for selecting flight vehicle power supplies for space are listed, and the features that make fuel cells attractive for aerospace applications are outlined. Conditions that fuel cells must satisfy during the prelaunch, launch, orbital, and planetary landing phases of spaceflight are listed. Finally, the major advantages and disadvantages of fuel cells are discussed for low-, medium-, and high-temperature ranges of operation. M.P.G.

N64-17402* National Aeronautics and Space Administration, Washington, D.C.
SPACE APPLICATIONS
Ernst M. Cohn *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 86–87 (See N64-17376 09-06)

The potential role of the fuel cell in space, not only as a power source but also as an energy storage device and as a chemical reactor, is discussed. Since none of the possible space power systems have reached their ultimate development, changes in their relative advantage positions may be expected as scientific advances occur. However, on long, manned missions where a closed or nearly closed ecology will be vital, biological fuel cells could be used to decompose human waste to reusable products with a minimum expenditure of energy, and to supply electrons within the human body. Regenerative fuel cells, whose waste products are regenerated by solar or nuclear energy, could act as both a power source and an energy sink. Fuel cells that are optimized for specific tasks and completely integrated into the systems of which they are parts must be developed. M.P.G.

N64-17403 Interior Dept., Washington, D.C.
CENTRAL STATION POWER
Neal P. Cochran *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 87–88 (See N64-17376 09-06)

The use of fuel cells to provide central electrical station power is discussed with reference to cost, efficiency, and fuel required. The development of fuel cell station power, which would be competitive with conventional coal-consuming power stations, is considered feasible today. In addition, the fuel cell power station would meet the substantial industrial requirement for d.c. power, which is presently satisfied only through the use of cost-increasing rectifiers. A system that will accomplish the gasification of coal with the energy provided by rejected heat from the cell or cell losses is under contract development. With commercial development and quality manufacturing of cell components, it is expected that by 1975 or 1980 fuel cells will be used for generation of large blocks of power with heat rates of 4,500 to 5,000 Btu/kw at capital costs of $150 to $175/kw with the added advantages of d.c. transmission. M.P.G.

N64-17404 Institute for Defense Analyses, Washington, D.C.
ECONOMIC AND LOGISTIC CONSIDERATIONS
G. C. Szego *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 88–92 refs (See N64-17376 09-06)

Discussed is the economic and logistic impact that would result from the development of hydrocarbon–air oxidation fuel cells to operate civilian and military traction vehicles. Statistics are presented, which show that a gasoline motor is approximately equal in output characteristics to an electric motor of about 1/6 to 1/4 of its power rating. This correspondingly reduces the capital investment cost for not only the electric motor and controls but also for the fuel cell battery. Tabulated comparisons of the capital and operating costs of gasoline engine vs fuel-cell-powered automobiles and off-highway trucks are presented. A list of advantages to be derived from the use of fuel cells as prime movers includes: (1) the possibility of regenerative braking; (2) reduced or eliminated air pollution; (3) reduced noise and vibration; (4) near-zero idling fuel consumption; (5) high efficiency under all ambient conditions; (6) increased efficiency with increased load; (7) elimination of auxiliary electric-power generators; (8) reduced ventilation requirements; and (9) feasibility of modular construction. M.P.G.

N64-17405 General Electric Co., Lynn, Mass.
PROGRESS WITH AIR-BREATHING SOLID-ELECTROLYTE FUEL CELLS
Eugene A. Oster *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 92–94 (See N64-17376 09-06)

Factors influencing the performance of hydrogen–oxygen, cation-exchange-membrane, solid-electrolyte fuel cells using ambient air as the source of oxygen are discussed. Studies of the maximum output obtainable from the cathodes of solid electrolyte fuel cells when operating on air and hydrogen showed that the limiting-current densities were directly proportional to oxygen concentrations for various sized air cathodes, and that a linear relationship exists between limiting currents and the square root of total absolute gas pressure. These results led to a study of the effect of air channel geometry on air cathode performance. A laboratory test model incorporating new air channel geometry concepts operated at power densities of 45 w/ft^2 of cell area at a cell output voltage of 0.6, which represents a fourfold performance gain over a 1961 model. These results justify the continued development of solid-electrolyte fuel cells for power-pack applications where light weight is important. M.P.G.

N64-17406 Allis-Chalmers Mfg. Co., Milwaukee, Wis.
FUEL CELLS FOR VEHICLES
Lester W. Buechler *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 94–95 (See N64-17376 09-06)

The types of ground vehicles in which the use of fuel cell systems would be advantageous and the problems involved in their use are discussed. The types of vehicles include: (1) army vehicles, using hydrogen and oxygen generated by nuclear energy at field energy depots; (2) fork lift trucks, in factories and warehouses where the trucks operate from a central location; and, eventually, (3) commercial trucking, for which fuel

cells offer greater potential efficiency in terms of cost per ton miles. The problems that are common to all fuel cell systems are cooling, moisture control, simplicity, and reliability. In addition, the manufacture and distribution of fuel is a particular problem facing the extensive use of fuel cells in vehicles. Actual fuel cell applications have been made in a golf cart and in a fork lift truck. The creditable performance of these vehicles is discussed, particularly with reference to the fork lift truck, which was operated with a nonnoble material as the catalyst in its fuel cell system. M.P.G.

N64-17407 Engelhard Industries, Inc., Newark, N.J.
DIRECT HYDROCARBON FUEL CELL
G. Cohn *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 96 ref (See N64-17376 09-06)
(Contract DA-36-039-SC-90691)

A new anode catalyst material that will permit operation of direct hydrocarbon fuel cells at lower temperatures than were previously considered feasible is reported. The results of tests in which the new material outperformed platinum catalysts in both polarization and stability in the temperature range 120° to 100° C are discussed. M.P.G.

N64-17408 Esso Research and Engineering Co., Linden, N.J.
THE METHANOL-AIR FUEL CELL
C. E. Heath *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 96–97 (See N64-17376 09-06)
(Contract DA-36-039-AMC-00134(E))

Progress in developing dissolved-fuel-type methanol–air fuel cells is reported. The methanol is dissolved into a circulating electrolyte that is fed to the anode; the anode and cathode are separated by an electrolyte-equilibrated porous membrane. Two types of cathodes are being developed: (1) a thin direct air electrode; and (2) an indirect redox system based on the reduction of a small amount of nitric acid as the cathodic reaction. The performance, advantages, and disadvantages of each are discussed; the selection of either will depend upon the particular fuel cell application. Work has begun on multicell units as a prelude to battery development, with emphasis on constructing larger units for military applications. M.P.G.

N64-17409 Electrochimica Corp., Menlo Park, Calif.
A HYDRAZINE FUEL CELL FOR AEROSPACE APPLICATIONS
Morris Eisenberg *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 97–99 (See N64-17376 09-06)

The development of a liquid hydrazine–oxygen fuel cell for aerospace applications is reported. The simple two-phase operation of this cell consists of (1) hydrazine (or UDMH) dissolved in electrolyte at porous metal anode electrodes and (2) oxygen flow behind the cathodes. A fuel utilization efficiency of 85% to 90% has been obtained with high current densities. The cell is self-starting at room temperature or below, and operates in the temperature range 20° to 35° C. A complete system for extended operation in orbiting satellites has been designed. Size and weight comparisons are made with a hydrogen–oxygen fuel cell system operating at the same output (300 w) for various mission times, and the results indicate that the hydrazine–oxygen fuel cell offers many advantages as a potential aerospace auxiliary power supply. M.P.G.

N64-17410 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Res. Labs
SOLID-ELECTROLYTE FUEL CELL FOR USE IN SPACE
D.H. Archer, E. F. Sverdrup, W. A. English, and James J. Alles *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 99–100 (See N64-17376 09-06)

The development and testing of hydrogen–oxygen solid-electrolyte fuel-cell batteries for space applications is reported. A zirconium oxide–yttrium oxide ceramic material, which conducts current by the passage of oxygen ions through its crystal lattice, was used as the solid electrolyte in the form of cylindrical bell-and-spigot tube segments. Electrodes of porous platinum were applied to both the inner and outer surfaces of the segments, which were then sealed together so that the inner electrode of one segment was next to the outer electrode of the next, forming a continuous gas-tight tube. The hydrogen fuel stream enters one end of the tube, reacts as it proceeds through the stack, and is exhausted from the other end as water vapor. The oxygen surrounds the outside of the tube. Data, obtained from an optimized demonstration battery consisting of three of these cells, indicate that a self-sustaining power system can be built that weighs less than 50 lbs/kw, and occupies about 0.3 ft^3/kw of installed capacity in plant sizes of 0.5 kw and larger. For space applications, solid-electrolyte batteries have the additional advantages of requiring neither cooling systems nor complicated combustion-product-removal systems, and of operating in any orientation with or without gravitational force. M.P.G.

N64-17411 General Motors Corp., Indianapolis, Ind.
NUCLEAR LIQUID METAL CELL FOR SPACE POWER
B. Agruss *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 100–103 (See N64-17376 09-06)

A nuclear liquid-metal cell system is proposed for space power supplies. This is a thermally regenerative system in which potassium and mercury are reacted electrochemically in a cell to produce power, and the resulting amalgam is brought to a boiler where the mercury is distilled away from the amalgam, regenerating the two reactants again. Laboratory data are presented, showing that the cell is completely reversible and electrochemically stable, that there is no polarization loss associated with charge or discharge, and that potassium diffusion is not a limiting factor in the region of 100 ma/cm^2. A thorough systems analysis has been made using the Snap II nuclear mercury-vapor turbine system, but replacing the turbine generator with the liquid-metal cell; the nuclear liquid-metal cell was lighter than the turbine, did not have to be designed for any one set power output, and had no moving parts. M.P.G.

N64-17412 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.
COMPARISON OF FUEL CELL SYSTEMS
Herbert F. Hunger *In its* Proc., 17th Ann. Power Sources Conf. [1963] p 103–104 (See N64-17376 09-06)

A brief comparison of the various fuel cell systems for different applications is made. For hydrogen–air fuel cells, hydrogen generator technology must be considered. In the power range from 100 w up to 1 kw, either ammonia cracking units (if weight is the determining factor) or kerosene–steam converters are attractive. Below 100 w, new hydrogen generation methods or the use of less conventional fuels will be necessary. For hydrocarbon fuel cells, water availability must be considered

in determining which hydrocarbon fuel is preferable, and whether the direct or indirect cell should be used. For low-temperature applications, methanol or hydrazine fuel cells might be preferable to hydrocarbon cells. Power level, weight, and volume considerations also justify the many approaches taken to make fuel cell batteries a military power source.
M.P.G.

N64-17413 Eagle-Picher Co., Joplin, Mo.
SEALED NICKEL-CADMIUM BATTERIES
E. B. Cupp *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 105–107 (See N64-17376 09-06)

In an effort to establish the failure modes of sealed nickel–cadmium cells, several of these cells were tested for the following critical failure modes: (1) fail shorted; (2) failed open; and (3) structural failure of cell containers. The causes of failure in each of these categories are tabulated. Two types of pressure-vented batteries were designed to overcome these failure causes; one type is compatible with radiation environments, and the other is designed for low-level radiation. Both were successfully environmentally tested. Studies are currently being directed toward improving the performance of sealed cells. New sealing techniques, improved ceramic seals, improved separation materials, and quality control measures have increased the life of cells to such a degree that reduced capacity due to extended cycle life, self-discharge, and poor charge acceptance are becoming the principal failure modes for these cells.
M.P.G.

N64-17414 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.
OPTIMUM CHARGE PROCEDURES FOR SEALED NICKEL-CADMIUM BATTERIES
Burton Resnic *In its* Proc., 17th Ann. Power Sources Conf. [1963] p 107–110 refs (See N64-17376 09-06)

Progress in establishing optimum charging methods for sealed nickel–cadmium cells under any given set of operating conditions is reported. Investigations to date have been confined to the constant current charging method. Data are presented that indicate that, from a practical standpoint, ambient temperature and charge time are of major importance. No real influence of either overcharge or cell charge states of 33% and 66% with 8- and 16-hour charging times was found. However, these conclusions must be considered as somewhat preliminary until the constant potential and pulse charging techniques have also been investigated.
M.P.G.

N64-17415 Gulton Industries, Inc., Metuchen, N.J.
STATE OF CHARGE METHODS FOR NICKEL-CADMIUM BATTERIES
M. Lurie, H. N. Seiger, and R. C. Shair *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 110–114 refs (See N64-17376 09-06)
(Sponsored by AF)

Several approaches to the measurement of the state of charge of nickel–cadmium batteries are being investigated. Of the five electrical properties of Ni-Cd cells studied (phase shift, ohmic resistance, double layer capacitance, transient peak height, and impedance at high audiofrequencies), the first two were found to depend upon the degree of charge in a manner useful as an indication of the state of charge. A phase shift apparatus is described that measures the residual capacity of cells and batteries with average errors from ±10% to ±20%; the disadvantages of this method include the necessity for frequent calibration, temperature dependence, and invalidity for batteries that have been on continuous repetitive automatic cycling. A device to measure the ohmic resistance, which varies with residual capacity, is also being developed. A third approach being investigated is the determination of the variation of the components of an equivalent circuit of a Ni-Cd cell with state of charge.
M.P.G.

N64-17416 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.
SEALED CADMIUM-SILVER OXIDE BATTERIES
Arthur M. Frink, Jr. *In its* Proc., 17th Ann. Power Sources Conf. [1963] p 114–116 (See N64-17376 09-06)

A survey of the accomplishments in sealed cadmium–silver oxide battery technology during the past year is presented. After a brief review of these battery systems, two new developments are discussed: (1) a chemically modified cellulosic film with amine groups introduced into the structure of the cellophane, which offers performance advantages as a separator material; and (2) an automatically activated sealed cadmium–silver oxide battery for high-temperature operation. The rest of the information reported pertains to cycle-life test results over a wide range of temperatures, cycle times, and depths of discharge in an effort to obtain the information required for the greater use of these cells.
M.P.G.

N64-17417 General Motors Corp., Anderson, Ind.
SEALED ZINC-SILVER OXIDE BATTERIES
J. A. Keralla and J. J. Lander *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 116–120 refs (See N64-17376 09-06)
(Contract AF 33(600)-41600)

The data presented show that the zinc–silver oxide battery is capable of sealed operation over hundreds of cycles when internal pressure buildup is controlled by limiting the charge voltage. Operation in this fashion is possible because Faradaic efficiencies for plate material utilization approaching 100% can be achieved. These data, although limited in testing scope in terms of cycle depth, temperature range, and time per cycle, provide a base line for performance of this system and disclose areas for research and development to achieve increased performance. It can be seen, when failure causes are examined, that they are all related to mass migration of the active material of the zinc plate.
Author

N64-17418 Calvin Coll., Grand Rapids, Mich.
SEPARATORS FOR ALKALINE BATTERIES
T. P. Dirkse *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 120–122 (See N64-17376 09-06)
(Sponsored by AF)

A study of the transport mechanism of silver in silver–alkaline cells and of the interaction of the silver with the separator materials is being made in order to reduce or eliminate internal shorting due to buildup of silver deposits on the separators. Two ways in which the deposit of silver can be built up are discussed: (1) direct interaction of the separator material with the silver oxides that are dissolved in the electrolyte; and (2) slow decomposition of the silver oxide dissolved in the KOH electrolyte, which produces a finely divided black material that has been identified as metallic silver. Analytical techniques and radioactive silver tracer techniques are being employed to determine when the silver oxide goes into solution during the cycling of an alkaline battery using silver electrodes.
M.P.G.

N64-17419 Cook Electric Co., Dayton, Ohio
EVALUATION OF SECONDARY BATTERIES
William G. Ingling and Walter W. Clark *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 122–124 refs (See N64-17376 09-06)

Results of a large-scale program of space battery evaluation are presented. The data tabulated and discussed include: (1) final results of cycle life tests of 10- and 20-cell nickel–cadmium batteries at depths of discharge from 25% to 75% at temperatures from 49° to −34° C; and (2) failure analyses of other sealed alkaline systems, including silver–cadmium and silver–zinc, as well as nickel–cadmium cells of different manufacture and capacity. These results will be useful in determining the probable useful life of these units in space environments and also in directing research efforts to increase the reliability, cycle life, and energy density of secondary batteries. M.P.G.

N64-17420 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.
PERCHLORATE RESERVE BATTERIES
Howard R. Knapp and Achille L. Almerini *In its* Proc., 17th Ann. Power Sources Conf. [1963] p 125–128 refs (See N64-17376 09-06)

Progress made in the development of reserve-type magnesium perchlorate batteries is discussed briefly. A summary of the advantages associated with the use of these batteries included the following: (1) Energy outputs of 50 to 55 whr/lb are obtainable from 30-min to 30-hr rates at room temperature. Over 40 whr/lb are obtained at −50° C with good battery insulation. (2) Voltage tolerance of ± 5% may be obtained at lower discharge rates (8 to 30 hr) at room temperature. A voltage tolerance of ± 10% to 12% is obtained at higher rates (30 min to 3 hr). (3) Rapid activation is achieved when put on load for meteorological applications, as opposed to water-activated systems that require a 10-min drain period to reach serviceable voltage. (4) Activated shelf life of one week is obtainable with use of the proper Mg alloy anodes. P.V.E.

N64-17421 Corson (G. and W. H.), Inc., Plymouth Meeting, Pa.
AMMONIA BATTERIES. PART 1: RESERVE LIQUID AMMONIA FUZE BATTERY
L. John Minnick *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 128–131 refs (See N64-17376 09-06)
(Sponsored by Navy)

A specific example of a liquid ammonia battery is described, which contains a magnesium anode and a metadinitrobenzene cathode depolarizer. Activation of the battery system is accomplished by electric pulse, with the use of a gas generator subassembly. Activation time of the battery under load occurs within 1 sec. The electrical output of the battery substantially exceeds the 2-min requirement over the temperature range of −55° to +74° C. Voltage regulation falls within the specified ±5% of the nominal voltage for all sections. Based on the batteries produced to this time, it is indicated that the liquid ammonia system may be employed successfully in a battery assemblage with characteristics eminently suited for fuze-type applications. Author

N64-17422 Eagle-Picher Co., Joplin, Mo.
AMMONIA BATTERIES, PART 2
L. R. Wood and D. J. Doan *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 132–134 refs (See N64-17376 09-06)

The current status of the development of batteries using liquid ammonia as an electrolytic solvent is discussed. Sheet magnesium anodes with either mercuric sulfate or silver chloride cathodes were used exclusively in multicell work, and both couples yielded approximately 2.3 volts open circuit. Presently fabricated batteries are capable of less than 1-sec activation to 80% peak load voltage, although times at −65° F vary from 0.45 to 3 sec. Projection and estimation of the energy per unit weight for present batteries is about 8 whr/lb. Coil and gas generator systems have been used as activation mechanisms in the liquid ammonia system. Multicell coulometric efficiency has been increased to approximately 70% to 80%, and times to 20% voltage-drop cutoff levels have been very consistent. Definitive measurements designed to isolate particular factors contributing to erratic cold activation have revealed that slow rise time is correlated to high a.c. impedance. P.V.E.

N64-17423 Electric Storage Battery Co., Raleigh, N.C.
LOW RATE SEALED ZINC-SILVER OXIDE BATTERIES
D. B. Colbeck *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 135–138 (See N64-17376 09-06)

Attempts to design, build, and test 3 models of low-rate cells, having nominal capacities of 20, 50, and 100 ampere-hours, are discussed. Tests have indicated that cells containing 1.62-mm-thick, DP-positive plates provided the highest combination of energy density (watt-hours per pound and per cubic inch) and efficiency (ampere-hours per gram of silver). Although the thinnest plates in the experiment gave the best performance, other work has indicated that decreasing positive-plate thickness to any value substantially below 1.62 mm would cause a decrease in energy density. Separator-material tests and separator-systems evaluation in cells stored while charged at 71° C revealed that, of all combinations studied, the following two combinations provided the best capacity for protection against charge loss, coupled with minimum space requirement: (1) one layer of ESB-Reeves White Synpor, 5 layers of cellophane, and (2) one layer of Dynel, 1 layer of Polypor WA, 4 layers of cellophane. It is concluded that, with the exception of having initial discharge voltages above desirable levels, presently fabricated cells meet or exceed all design objectives. P.V.E.

N64-17424 Naval Ordnance Lab., White Oak, Md.
LECLANCHE BATTERY SHELF LIFE STUDY
D. L. Warburton *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 138–142 refs (See N64-17376 09-06)

The study showed that: (1) The temperature of −34° C is a safe and effective storage temperature when batteries are heat-sealed in 100μ-thick polyethylene bags. (2) The shelf loss at 21° C is reduced by approximately one order of magnitude by storage at −34° C. (3) The average rate of capacity loss, ignoring cell size, end voltage, and discharge rate is 21, 11, 7, and 2.6 percent per year for storage at 21°, 4°, −12°, and −34° C, respectively. (4) The actual shelf life of a particular battery is dependent upon cell size, end voltage, and discharge rate. These factors must be taken into consideration when establishing shelf life estimates for a specific application. (5) The large product variability observed in Leclanche batteries indicates that long shelf life at 21° C and reliability levels above 75% are not compatible with each other. Author

N64-17425 Dow Chemical Co., Midland, Mich.
INVESTIGATION OF THE MAGNESIUM ANODE
J. L. Robinson *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 142–144 refs (See N64-17376 09-06)

The possibility of substantially increasing the usable portion of energy available in various magnesium primary-cell systems was investigated. The following observations were made as a result of the investigation of magnesium anodes: (1) The observed behaviors of the magnesium anodes strongly suggest that the electrode processes are film controlled. (2) Despite the high degree of order observed, the governing reactions in the anodic behavior are not clearly defined. (3) It was demonstrated that the coulombic inefficiency of magnesium can be eliminated in an operating system, which means that substantially improved primary cells are possible. (4) At the current state-of-the-art, magnesium systems based on organic-salt electrolytes would have limited application due to high internal resistances. P.V.E.

N64-17426 Monsanto Research Corp., Everett, Mass.
NEW ORGANIC DEPOLARIZERS
E. A. Mc Elhill, D. L. Williams, and B. A. Gruber *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 145–148 refs (See N64-17376 09-06)
(Sponsored by Army)

The method devised for testing organic compounds for depolarizer activity has shown the relative importance of the effect of chemical structure of depolarizer and outside physical effects on activity. In the early stages of discharge, effects of chemical structure are detected: there is correlation of initial reduction potentials of substituted nitrobenzenes with electronegativity of substituents as measured by Hammett σ constants. Physical changes produced in the cathode during discharge, such as loss of conductivity of electrolyte or plugging of cathode by bulky products, have a larger effect on reduction potential as reaction proceeds and overshadow the structural advantages of individual depolarizers. Author

N64-17427 Radio Corp. of America, Somerville, N.J.
CARBON BLACKS FOR ORGANIC DEPOLARIZED BATTERIES
G. S. Lozier and J. B. Eisen *In* Army Signal Res. Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 149–152 refs (See N64-17376 09-06)
(Contract DA-36-039-SC-87243)

The optimum performance of magnesium cells depolarized with m-DNB is tied to a set of properties not usually assembled in a commercial carbon black: (1) an open or fluffy state, with a tapped density below 0.1; (2) a degree of persistent structure, showing resiliency in compression; (3) the 2:1 m-DNB–carbon cathode mix should retain 3.5 ml water (in electrolyte) per gram of carbon black, without syneresis. (4) At a compression ratio of 10 the dry cathode mix should retain at least 75% of the electrical conductivity of the carbon black. (5) A chemically bonded trace of certain elements, such as Cr, Fe, Ni, Co, and Mo, but especially vanadium. Carbon blacks of nominally identical, high surface areas are readily demonstrated to differ widely in the presence of cathode mix ingredients, e.g., the adsorption of m-DNB. Author

N64-17428 Minneapolis-Honeywell Regulator Co., Hopkins, Minn.
LOW INPUT VOLTAGE CONVERSION
J. T. Lingle *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 153–155 ref (See N64-17376 09-06)
(Contract DA-36-039-SC-90808)

A transistor device is described that can convert the output of a single cell (fuel cells, solar cells, thermionic diodes, thermoelectric junctions, etc.) or a minimum number of series-connected cells to one or more usable output voltages. The circuit consists of a starting oscillator, a power amplifier, a rectification circuit, and a filter. For a converter designed to convert 1.5 volts to a 50-watt, 28-volt d.c. output, it was found that: with a 1.5-volt input, the efficiency was 79.7% at 50 watts, and for a 30-watt load, the efficiency was 82.7%. In a 0.6 to 0.9 input voltage range, maximum efficiencies between 73.5% and 79.5% were obtained. From the performance curves that are presented, it is concluded that transistor converters are a practical and efficient method of converting the low input voltage of newer energy conversion power sources and single-cell electrochemical sources to more usable higher voltages. P.V.E.

N64-17429 Army Signal Research and Development Lab., Fort Monmouth, N.J. Electronic Components Dept.
UNSYMMETRICAL LOW VOLTAGE CONVERTER
William L. Dudley *In its* Proc., 17th Ann. Power Sources Conf. [1963] p 155–158 refs (See N64-17376 09-06)

A single-ended control circuit for switching one thermionic diode between conducting and nonconducting states in an unsymmetrical fashion to produce an a.c. voltage was investigated for the purpose of increasing the a.c. overall efficiency from the heat input to the power used by the load. The thermionic diode was considered as a steady-state d.c. source that will be alternately connected and disconnected to a load by a transistor switch at some optimum ratio of "on" to "off" time. The feasibility of the technique is demonstrated, although an increase in efficiency and power capacity must be achieved for a practical conversion system. Some advantages of the described system over a two-diode push-pull inverter are: (1) lower fuel requirements; (2) greater reliability; (3) fewer expensive components; and (4) reduced size and weight. P.V.E.

N64-17430 Radio Corp. of America, Somerville, N.J.
TUNNEL DIODE CONVETERS
F. M. Carlson and P. D. Gardner *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 158–162 refs (See N64-17376 09-06)
(Sponsored in part by AF and Navy)

At the low output voltages provided by the new power sources, the tunnel diode inverter has great promise as an efficient means of d.c. to a.c. inversion. Such an inverter can tolerate higher radiation levels and wider temperature ranges than transistors and SCR's so that it is attractive for severe environments. Design equations show that the diode performance is independent of current level, and allow the optimization of efficiency and junction temperature rise by a proper choice of materials and fabrication techniques. The circuits necessary for operating tunnel diodes as inverters are simple, and they operate over wide ranges of input voltage and load resistance. The applicability of such inverters to provide high output voltages at high efficiency from thermionic and thermoelectric generators is demonstrated. Author

N64-17431 United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.
MODULAR POWER CONVERTER SYSTEMS
Frank L. Raposa *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 163–166 (See N64-17376 09-06)

Modular power converters have the capability of satisfying many different applications requirements through proper integration of the basic building blocks of the system. Regulated power supplies and nonregulated power supplies are made available by adding or removing the voltage regulating blocks of the system. Output voltages of any magnitude are obtained by the selection of the proper output transformer. Any number of simultaneous output voltages can be obtained by paralleling output stages. Additional types of power supplies are made available by proper integration of the voltage regulating blocks. Operation over variable input voltage ranges and operation for multiple output power levels are obtained by suitable scaling of the basic design. Author

N64-17432 General Electric Co., Lynn, Mass.
SWITCH MODULATION TECHNIQUES IN AC TO DC POWER SUPPLIES, PART II
Francisc C. Schwarz *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 167–170 refs (See N64-17376 09-06)

The frequency-modulated, self-stabilizing inverter, as used in regulated a.c.-to-d.c. power supplies, is discussed. Two experimental models of such power supplies at the 260- and 600-watt levels to provide 26 volts d.c. and 22 to 30 volts d.c., respectively, are described. P.V.E.

N64-17433 Unitron, Inc., Garland, Tex.
STATIC FREQUENCY CONVERTER
D. E. Davis *In* Army Signal Res. and Develop. Lab. Proc., 17th Ann. Power Sources Conf. [1963] p 170–173 (See N64-17376 09-06)

A technique is presented for converting 400-cps three-phase power to 60-cps single-phase power. The conversion technique described has been successfully employed at power levels from 1.5 kv-a to 8.0 kv-a. Power-to-weight ratios up to 27-volt amperes per pound have been achieved when operating at output-power distortion levels below 5.0%. Efficiencies of greater than 90% have been realized in all experimental cases. Output-voltage regulation of ± 2.0% was easily obtained under extreme conditions of input line, load, and temperature. P.V.E.

N64-17492* Sonotone Corp., Elmsford, N.Y. Battery Div.
IMPROVING PERFORMANCE AND RELIABILITY OF SEALED SECONDARY TYPE NICKEL CADMIUM STORAGE BATTERIES FOR SATELLITE AND SPACE APPLICATION Final Report, 10 Jan. 1961–11 Jan. 1963
Peter R. Voyentzie [1963] 93 p
(NASA Contract NAS5-977)
(NASA CR-53258) OTS: $8.60 ph, $2.99 mf

Improvement in the performance and reliability of the hermetically sealed, cylindrical type, nickel–cadmium "space battery" is reported. Leak-detection techniques and fixture were designed specifically for battery components. The glass-to-metal hermetic seal was improved, as was the ceramic seal. The latest improvement in the ceramic seal is the use of a vacuum-tube grade of silver brazing alloy in place of the 82% gold–18% nickel braze. Various irradiated separator materials were investigated; the only one with promise was a nonwoven polypropylene with a strong acid graft. It was shown that the intercell wiring arrangement is a more important factor in creating magnetic-field intensity than the battery itself, and that this field can be kept at a minimum by a proper wiring arrangement. R.T.K.

N64-17533 Atomic Energy Commission, Washington, D.C.
SYSTEMS FOR NUCLEAR AUXILIARY POWER Report by the Commission – 1964
Feb. 1964 24 p
(TID-20103) GPO: $0.25

A general report on the SNAP program, with emphasis on space applications, is presented. The topics discussed include SNAP uses; alternate systems; the role of nuclear energy; present radioisotope and nuclear-reactor programs; the general technical approach to future radioisotope, nuclear-reactor, and power-generation systems; and the relationship of the "user" agency and the AEC. The report concludes that: (1) Nuclear power offers unique advantages to a wide variety of space missions. (2) The performance of ambitious space missions will require amounts of reliable power so large that they can be achieved only from nuclear systems. (3) SNAP reactor technology must be developed to meet power requirements within several power ranges. (4) SNAP technology must be developed with full consideration of integration of the converter with the nuclear heat source. (5) The AEC part of the program should extend through the demonstration phase where first-of-a-kind technology and equipment are involved. (6) The orderly development through the demonstration phase will provide users with the information and experience needed in planning their missions. M.P.G.

N64-17581* Rensselaer Polytechnic Inst., Troy, N.Y.
ADAPTIVE CONTROL FOR NUCLEAR REACTOR START-UP AND REGULATION First Semi-annual Status Report, July 1–Dec. 31, 1963
C. N. Shen Jan. 1964 5 p refs Presented at the 9th Ann. Meeting of the Am. Nucl. Soc., Salt Lake City, Jun. 1963 Submitted for publication
(NASA Grant NsG-14-59, Suppl. II)
(NASA CR-53179) OTS: $1.10 ph, $0.80 mf

An optimized control system having several features that make it superior to conventional feedback systems is described. The optimization procedure defines in precise mathematical terms the purpose of the control system. The usual power overshoot, which was inherent, for example, in Kagayama's system, was eliminated. The optimum system requires amplifiers with time varying gains. Included in this document are the equations on which the optimum control system is based and a complete diagram of the system. R.T.K.

N64-17586* Marquardt Corp., Van Nuys, Calif.
STUDY OF BIOCHEMICAL FUEL CELLS Third Quarterly Progress Report, 1 Nov. 1963–31 Jan. 1964
George E. Ellis and Edward E. Sweeney [1964] 29 p refs
(NASA Contract NASw-654)
(NASA CR-53178; Rept. 25124) OTS: $2.60 ph, $1.07 mf

Investigations were continued to determine the effect of the feces–urine ratio upon the electrochemical characteristics of the biochemical fuel cell. It was concluded that the feces–urine ratio has a relatively minor effect over the range from 10 to 40 g of feces per 100 ml of urine. Chemical–electrochemical reactions were separated from biochemical fuel cell reactions by isolating the microorganisms from the anode by means of a cellulose acetate membrane, but products formed by the metabolic reactions could diffuse through the membrane to the anode. The data showed that the electrochemical power output of the cell increased with time, over the 170 hours of the experiment, apparently because of the formation of electrochemically active metabolic products that diffused to the anode. Author

N64-17589* General Dynamics Corp., San Diego, Calif. General Atomic Div.
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Quarterly Progress Report, Period Ending Nov. 30, 1962
L. Yang, A. F. Weinberg, F. D. Carpenter, R. G. Hudson, C. W. Savery et al [1963] 85 p refs
(NASA Contract NAS3-2532)
(NASA CR-53220; GA-3866) OTS: $8.10 ph, $2.75 mf

Research activities in the following areas are summarized: (1) long-term tests (>1000 hr) of the rate of vaporization of UC in cesium vapor and of the emission stability of UC-ZrC and W-clad UC in cesium vapor; (2) studies of the high-temperature properties of UC-ZrC—effect of density on the rate of vaporization and electron emission of UC-ZrC in vacuum, redeposition studies, thermionic emission microscopy, and high-temperature mechanical properties; (3) irradiation studies; (4) studies of new cathode materials—emission, diffusion, and diffusion–emission; and (5) fabrication development. P.V.E.

N64-17603* Lear Siegler, Inc., Cleveland, Ohio Power Equipment Div.
BRUSHLESS ROTATING ELECTRICAL GENERATORS FOR SPACE AUXILIARY POWER SYSTEMS Second Quarterly Report [26 Oct. 1963-26 Jan. 1964]
J. N. Ellis and F. A. Collins 31 Jan. 1964 255 p
(NASA Contract NAS3-2783)
(NASA CR-53221) OTS: $16.50 ph, $7.85 mf

This report contains a design calculation procedure and a FORTRAN II computer program for synchronous, wound-pole, salient-pole generators. In addition, it contains the design calculation procedure for Lundell generators. Losses in solid pole faces and the design limits imposed by them are discussed. Lundell generators have limits of stator length to rotor diameter that cannot be profitably exceeded. These are discussed. A brief discussion of the motor starting characteristics of salient pole generators is included. Author

N64-17606* General Motors Corp., Indianapolis, Ind. Allison Div.
DEVELOPMENT AND TESTING OF ELECTROLYTE MATRIX COMBINATIONS FOR MERCURY-POTASSIUM FUEL CELL Fourth Monthly Progress Report, 12 Mar. 1963-12 Apr. 1963
V. L. Decker and T. F. Nagey 25 Apr. 1963 5 p
(NASA Contract NASw-476)
(NASA CR-53297; EDR-3314) OTS: $1.10 ph, $0.80 mf

Progress in the following areas is discussed: (1) Compressive strength measurements on coarse grain composites—A 34% composite was made up by adding MgO to a previously prepared 35% composite mixture. Strength tests varied from 3.6 to 6.5 psi on 85%- to 90%-dense material. (2) Development of fine grain composites—Strength and flowability tests were conducted on specimens made from 55% electrolyte and having a theoretical density of 87%. At 350° C the strength was 11 psi and flowability showed 4% deformation at rupture. (3) Small cell testing—In the first cell tested, a 33% electrolyte composite with a theoretical density of 86.2%, was used and in the second cell tested, a fine grain composite of 55% electrolyte was used. In the first test, stable cell performance was obtained during the first 38 min. P.V.E.

N64-17622 Union Carbide Consumer Products Co., Cleveland, Ohio Electrochemical Product Development Lab.
OBJECT– RESEARCH/DEVELOPMENT WORK ON ALKALINE-MnO_2 BATTERY 6th Quarterly Report, 1 Aug.-31 Oct. 1963
J. Winger 6 Dec. 1963 30 p
(Contract DA-36-039-SC-89098)
(AD-433225)

Work done in a series of sequential experiments has indicated that the Mix 234 cathode formulation, Pellon separators, and Steel cans will be carried through to factory trials. Cathode molding parameters beyond the range of normal tolerances have indicated that high moisture content (29% solution volume) mixes are best for cell performance. Interactions between cathode preform weight and mix moisture content affect cathode density and percent cathode packing and subsequent cell service. Statistical design of experiments and subsequent testing have shown the full factorial design to be best in determining main effects and interactions when wide differences in temperature-dependent mean values are involved, e.g., between –40° F and 70° F. Author

N64-17681* Clevite Corp., Cleveland, Ohio Electronic Research Div.
STUDY OF THIN FILM LARGE AREA PHOTOVOLTAIC SOLAR ENERGY CONVERTER Third Quarterly Report, 1 Apr.-30 Jun. 1963
Warren J. Deshotels, Frank Augustine, Allan Carlson, J. Koenig, and M. P. Makowski 19 Jul. 1963 64 p refs
(NASA Contract NAS7-203)
(NASA CR-55738) OTS: $6.60 ph, $2.12 mf

The effort expended on CdS solar cells has been about evenly divided between evaporated films and single crystals or multicrystals. Improvements in the evaporator are discussed along with optical and electrical measurements made on CdS films and film cells. Detailed descriptions are given of experiments performed on a film as it is processed into a photocell. These are optical transmission of the film before processing, after processing with the copper slurry, and after final heat treatment and formation of the barrier layer; spectral response of the completed cell; efficiency of the cell; and Hall effect and resistivity measurements on the film before processing. A similar set of data are presented for a single crystal cell. Author

N64-17682* Electro-Optical Systems, Inc., Pasadena, Calif.
EVALUATION OF REGENERATIVE FUEL CELL Addendum Report
Harvey A. Frank 2 May 1962 10 p
(NASA Contract NAS7-7)
(NASA CR-55847; EOS-1584, Addendum) OTS: $1.10 ph, $0.80 mf

Results are given of experimental investigations of the characteristics of a regenerative hydrogen–oxygen fuel cell. The study included experimentation with both a single-cell unit and a multicell unit. Environmental tests conducted on a single cell included acceleration, vibration, and shock. The test conditions and cell performance during these tests are given. With the multicell unit, cell reversal was found on several occasions during discharge. The voltage of one of the 9 cells in the unit was found to drop suddenly to zero, and then to become negative. This occurred as a result of a faulty cell that cannot maintain a voltage as high as the other, and is subsequently given a negative charge. In order

to establish the causes for a cell becoming faulty and reversing while on discharge, a series of experiments were carried out and are described. C.L.W.

N64-17687* Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
RESEARCH AND DEVELOPMENT OF AN OPEN-CYCLE FUEL CELL SYSTEM Monthly Progress Report, 1 Jul.-31 Jul. 1963
David P. Ghere et al 15 Aug. 1963 9 p
(NASA Contract NAS8-2696; Proposal Request TP 2-831321)
(NASA CR-55966; Rept. 15) OTS: $1.10 ph, $0.80 mf

The testing activities were concentrated on development of a liquid cooling system for the breadboard recirculation system. R.T.K.

N64-17698* Republic Aviation Corp., Farmingdale, N.Y.
SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY. VOLUME 4, ATTITUDE AND STATION CONTROL Final Report, Feb.-May 1963
17 Jun. 1963 256 p refs
(NASA Contract NAS5-3189)
(NASA CR-55929; RAC-1333; SSD-1027) OTS: $16.50 ph, $7.88 mf

Detailed surveys and analyses of the following subsystems and related technical problems are discussed: (1) attitude control—attitude reference sensor survey, torquers, disturbance torques, 3-axis stabilized spacecraft, gravity-gradient spacecraft, spin-stabilized spacecraft, and earth tracking—dynamic analysis and simulation, earth acquisition and reacquisition; (2) orbit getting and stationkeeping; (3) control and stationkeeping system implementation; and (4) system implications of Atlas-Agena injection errors. R.T.K.

N64-17699* Republic Aviation Corp., Farmingdale, N.Y.
SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY. VOLUME 5: COMMUNICATIONS, POWER SUPPLY, AND THERMAL CONTROL [Final Report, Feb.-May 1963]
17 Jun. 1963 312 p refs
(NASA Contract NAS5-3189)
(NASA CR-55928; RAC-1333, Vol. 5, SSD-1027, Vol. 5) OTS: $19.75 ph, $9.56 mf

Detailed surveys and analyses of the following are included: (1) communications—general parametric relationships and systems descriptions; (2) data handling—sensor data system, command data system, and telemetry system; (3) power-system study—solar, nuclear, and chemical power; microwave transmitted power; a summary of power sources and energy-storage systems; space-radiation effects on solar cells at synchronous orbit; power-system design considerations; and power and energy requirements of the SMS power system; (4) thermal control—factors influencing thermal design, passive temperature control, semiactive temperature control, active temperature control, infrared cooling, and solar cells. R.T.K.

N64-17710* National Aeronautics and Space Administration, Washington, D.C.
PERSPECTIVES ON BIOCHEMICAL ELECTRICITY
Ernst M. Cohn Repr. from Develop. Industr. Microbiol., v. 4, 1963 p 53-58 refs
(NASA RP-147)

Both empirical experimentation and fundamental approaches should be pursued for optimum rates of development in the art and science of biochemical fuel cells. Three distinct methods of operation are already under study: imitation of life processes for generating electricity, indirect use of biological reactions to generate products useful as fuels, and direct use of organisms or enzymes on electrodes to act as fuel-cell catalysts. The usefulness of biocells to the civilian power economy of an industrial nation is likely to remain insignificant for a very long time. Conventional fuels, power generating stations, and motive engines are difficult to compete with where costs, chemical reaction rates, and power densities are concerned. Bioelectrochemical power could conceivably be of great significance to fuel-poor underdeveloped countries. Materials such as organic matter in fresh and salt water, plant and animal debris, garbage, and body wastes can all be considered as potential sources of electricity. Author

N64-17719 Pratt and Whitney Aircraft, Middleton, Conn.
LCRE AUXILIARY SYSTEMS TERMINATION REPORT
H. J. Banach 9 Mar. 1964 96 p refs
(Contract AT(30-1)-2789)
(PWAC-416) OTS: $2.25

The Lithium-Cooled Reactor Experiment (LCRE) was designed as a "proof-of-principle" test for a lithium-cooled, high-temperature, intermediate-fast-flux, 10-Mw reactor. This report describes the functional design of the LCRE auxiliary systems and the development work and tests that were completed, in process, or planned. It also gives the procurement and fabrication status of these systems and includes manpower and cost expenditures and estimates. The auxiliary systems include all reactor systems except the main liquid-metal coolant loops, and the reactor control and safety systems. Author

N64-17760* Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.
PARALLEL INVERTER AND CONVERTER OPERATION AND IMPROVEMENTS IN TRANSFORMERS Second Quarterly Report, 28 Sep.-27 Dec. 1963
G. W. Ernsberger and H. R. Howell 1963 57 p refs
(NASA Contract NAS3-2792)
(NASA CR-54012) OTS: $5.60 ph, $1.91 mf

Fabrication of two static inverter-converter testmodels was started and about 60% completed. Transformer laminations were punched from Cubex steel for the static-inverter output-transformer test model. A test procedure was designed and written for laboratory evaluation of the test models. Author

N64-17767* Goodyear Aerospace Corp., Akron, Ohio Space Systems Div.
RIGIDIZED INFLATABLE SOLAR ENERGY CONCENTRATORS First Monthly Progress Report, 30 Sep.-31 Oct. 1963
N. Jouriles and C. E. Welling 7 Nov. 1963 19 p
(NASA Contract NAS1-3301)
(NASA CR-53316; GER-11318) OTS: $1.60 ph, $0.80 mf

A number of azide structures have been reviewed and a number of preliminary investigations have been performed to learn more of the physical properties of the azides and their resulting polyurethane foam products. The approach of reducing peak temperatures by control of rate-of-decomposition of the azide and rate-of-gelation of the polyurethane foam has been pursued. Progress in these areas is discussed. A program schedule, a schedule forecast of manpower utilization, and a schedule forecast of fund expenditures are presented. Author

N64-17768* Goodyear Aerospace Corp., Akron, Ohio Space Systems Div.
RIGIDIZED INFLATABLE SOLAR ENERGY CONCENTRATORS Second Monthly Progress Report, 1-30 Nov. 1963
N. Jouriles and C. E. Welling 6 Dec. 1963 9 p refs
(NASA Contract NAS1-3301)
(NASA CR-53298; GER-11318 S1) OTS: $1.10 ph, $0.80 mf

Work accomplished included the following: (1) Polyol resins were collected for evaluation as the resin component of precoat formulations. Preliminary experimentation has been done with one polyether octol with a heterocyclic nucleus. A source for p-phenylene diisocyanate has been located. A simple purification procedure has been found and applied to commercially available 4,4'-diphenyl methane diisocyanate to produce a purified material. (2) A test apparatus has been assembled and calibrated to determine the heat of decomposition of candidate azide materials. (3) A preliminary study of standard methods for the evaluation of shock and friction sensitivity of azides has been made. A test fixture has been designed for measuring the sublimation tendencies of azides and polyol materials in high vacuum. A method of determining the density of foam samples has been developed that employs sand displacement to measure sample volume. P.V.E.

N64-17769* Goodyear Aerospace Corp., Akron, Ohio Space Systems Div.
RIGIDIZED INFLATABLE SOLAR ENERGY CONCENTRATORS Third Monthly Progress Report, 1-31 Dec. 1963
N. Jouriles and C. E. Welling 23 Jan. 1964 11 p
(NASA Contract NAS1-3301)
(NASA CR-53299; GER-11318 S2) OTS: $1.60 ph, $0.80 mf

On the basis of past development efforts, three new azide structures were designed and ordered. Small quantities of these structures have been delivered and are undergoing formulation and screening tests. Some new polyol resins were obtained and will be used in combination with the azides to produce an improved rigidizing material. Trial runs were made on several new combinations. A number of experimental foams were produced by heat triggering in partially evacuated environments. The technique of determining the "heat of decomposition" has been developed, and tests have been run on several structures where measurements show good relative consistency. An azotometer has been assembled, and the nitrogen release has been determined for several azide structures. An apparatus has been built to determine the sublimation tendency of the azide–polyol combination in vacuum and at temperature. A "Vicat softening point" apparatus is being investigated for screening tests. Author

N64-17770* Goodyear Aerospace Corp., Akron, Ohio Space Systems Div.
RIGIDIZED INFLATABLE SOLAR ENERGY CONCENTRATORS Fourth Monthly Progress Report, 1-31 Jan. 1964
N. Jouriles and C. E. Welling 7 Feb. 1964 9 p
(NASA Contract NAS1-3301)
(NASA CR-53300; GER-11318 S3) OTS: $1.10 ph, $0.80 mf

Measurements have been made for the chemical and physical properties of the available azides. Studies have been made of the formulation variations and their effects upon strength and temperature. A Vicat softening apparatus has been constructed to aid in these investigations. Azotometer, heat-of-rearrangement, and sublimation tests have been performed for most of the available materials. Some of the data indicate that a near optimum azide material may have been obtained. Greater consideration in the area of prepolymerization is expected to offer an improved material reaction. Author

N64-17823* Hughes Aircraft Co., Culver City, Calif. Materials Technology Dept.
RIGIDIZED INFLATABLE SOLAR ENERGY CONCENTRATORS Second Quarterly Progress Report, Nov. 1963-Feb. 1964
S. Schwartz Feb. 1964 36 p
(NASA Contract NAS1-3244)
(NASA CR-53356; P64-08) OTS: $3.60 ph, $1.28 mf

The investigation of various gel coat materials was continued. Gel coats investigated included polysulfides, epoxy-polyamides, epoxy-polysulfides, urethanes, and thin coatings of polyester resin. A number of tests were made to attempt to determine the causes for optical distortion and possible means of minimizing the distortion. Distortion was found to be definitely related to degree and rate of cure of the rigidizing resin and was also related to use of a fabric reinforcement. Epoxy resins appeared to show less distortion than did polyesters. Incorporation of a powdered filler instead of fabric, particularly hollow, phenolic microballoons, resulted in much improved optics. Techniques of evenly distributing a microballoon-filled resin (a syntactic foam) over a relatively large surface remain a problem. Author

N64-17841 Joint Publications Research Service, Washington, D.C.
THE DEVELOPMENT OF PNEUMATIC AUTOMATION IN SOVIET TECHNOLOGY
I. Makarov and A. Dubov 6 Apr. 1964 6 p Transl. into ENGLISH from Izv. (Moscow), 4 Feb. 1964 p 5
(JPRS-24036; OTS-64-21986) OTS: $0.50

The Universal System of Units of Industrial Pneumatic Automation (USEPPA) consists of a set of integrated units of discrete and continuous action, each performing a very simple function. There are about 20 of these units—pneumatic relays, adders, storage units, units of pneumatic resistance, capacity, etc. Externally resembling a radio tube, each of the elements contains one or more diaphragms. Linking of the elements is effected by a type of printed installation similar to that used in radio engineering, except that pneumatic linkages are used. Simple and multiple-cycle relay circuits can be constructed on USEPPA elements, and can perform any logical operations. With these elements, it is possible to create not only the ordinary system of automatic stabilization but also an automatic system for deriving optimum efficiency from processes, and even one for telemechanics installation, not previously common in pneumatic automation. Also, jet-technology instruments are discussed. These instruments are made by the printed-circuit method. As primary jet cells, it is possible to use functional blocks: moduli such as the flip flap, single-digit adders, analog computing amplifiers, etc. On the basis of these, it is very simple to fashion various control mechanisms, including digital mechanisms. A number of jet-technology instruments have been successfully tested in chemical and natural-gas plants. I.v.L.

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-16922 College of Aeronautics, Cranfield (Gt. Brit.)
AN EXAMINATION OF THE METHODS OF MIXING PEROXIDES INTO POLYTHENE TO FORM POLYMER NETWORKS
J. M. Stuart Oct. 1963 11 p refs
(CoA-N-Mat. 2)

In the production of peroxide cross-linked polyethylenes it is customary to introduce the organic peroxide by the hot milling process. Inevitably some peroxide is lost by volatilization, and the process is, therefore, difficult to standardize. In this paper, the efficiencies of the processes in which the peroxide is introduced by wet and dry powder mixing are compared with the efficiency of the normal method of mill mixing. It is shown that in both the wet and dry processes the loss of peroxide is avoided, but that the dry mixed material shows nonhomogeneities in the cross-linked state. Author

N64-16926 European Atomic Energy Community, Brussels (Belgium)
THE DETERMINATION OF TRACE AMOUNTS OF INORGANIC COMPOUNDS IN POLYPHENYLS BY X-RAY SPECTROGRAPHY [LE DOSAGE DES TRACES MINERALES DANS LES POLYPHENYLES PAR SPECTROGRAPHIE X]
G. Vos Joint Nuclear Res. Center, Ispra Establishment (Italy), Jan. 1964 23 p refs Presented at the 25th Ann. Congr. of the Group for Advan. of Spectrographic Methods, Paris, 24–27 Jun. 1963 In FRENCH; ENGLISH abstract
(EUR 478.f) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 40 Belg. Fr.

A large number of elements such as Zr, U, Fe, Cr, Ni, Mn, Co, Cu, Zn, Ca, S, P, Cl can be determined in polyphenyls by X-ray spectrography. Detection limits extend from some tenths of ppm for the elements between Ca and U, up to some ppm for the lighter elements, i.e., P, S, and Cl. Author

N64-16934 Los Alamos Scientific Lab., N. Mex.
THE GRAVIMETRIC DETERMINATION OF TRACE AMOUNTS OF CARBON IN SODIUM METAL
Ross D. Gardner and William H. Ashley 5 Mar. 1964 15 p refs
(Contract W-7405-ENG-36)
(LA-3035) OTS: $0.50

The classical combustion–gravimetric method for the determination of carbon has been modified and applied to the measurement of trace amounts of carbon in sodium metal. The sample, contained in an aluminum capsule, was reacted with a flux consisting of a mixture of boric anhydride and vanadium pentoxide and burned in a stream of purified oxygen at 1,100° C. An average recovery of 96% with a standard deviation of 10 ppm was obtained for the analysis of 40 samples containing known amounts of carbon in the 0 to 200 ppm range. Author

N64-16963 Florida U., Gainesville Engineering and Industrial Experiment Station
FLUOROCARBON N-F COMPOUNDS Eighteenth Quarterly Technical Report
R. D. Dresdner, J. Merritt, J. S. Johar, and J. P. Royal 1 Jan. 1964 9 p refs
(Contract DA-01-009-ORD-772; ARPA Order 40-59)
(AROD-007-18; AD-430053)

Further information leading to better product data on the UV-stimulated reaction between $R_fN{=}SF_2$ and N_2F_4 is reported. Yields of NF_2SF_5 approaching 95% are attainable. Secondary reactions between sulfur-bearing intermediates or NF_2SF_5 seem to react with glass at room condition during and after the exposure reaction. Similar work with cyanogen and N_2F_4 has lead to the products $NF_2CF_2CF_2NF_2$, NF_2CF_2CN, and $C_2F_5NF_2$. Chain retention approaches 80%. The reaction of $(CN)_2$ and SF_4 has resulted in samples of $CNCF_2N{=}SF_2$ and $(CF_2N{=}SF_2)_2$. Attempts to perfluoroalkylate $CNCF_2N{=}SF_2$ via the sulfur atom over CsF using $CF_3CF{=}CF_2$ produced a multiplicity of products, some extremely high boiling, but no available $CNCF_2N{=}SC(CF_3)_2$. Work has been initiated to study the reaction of $C_2F_5N{=}SF_2$ and HgF_2 at 100° C. Author

N64-16987 Rock Island Arsenal, Ill.
SYNTHESIS OF ELASTOMERS CONTAINING BORON
Lynn G. Wiedenmann 23 Jan. 1964 18 p refs
(RIA-64-230; AD-432014) OTS: $0.75

Monomers containing the 1,2-dicarbaclovododecarborane unit (carborane, $>C_2B_{10}H_{10}$) were prepared from substituted acetylenes and decarborane. A tough elastomer was produced by the emulsion copolymerization of butadiene and isopropenylcarborane. Polyesters were prepared from bis(hydroxymethyl) carborane and succinic, perfluoroglutaric, adipic, and terphthalic diacid chlorides. The polycarborane adipate was a soft, tough, partially elastomeric material of low melting point. Weight losses, after air oven aging of the raw polyesters, were obtained and found to be lower than those of a typical commercial polyester. A polymer prepared from bis(acryloxymethyl) carborane and methylphenylsilane was highly crosslinked. An analogous polymer, but without boron, was prepared from butylene dimethacrylate and methylphenylsilane. Author

N64-17024 Joint Publications Research Service, Washington, D.C.
ANALYSIS OF GASES IN MOLYBDENUM SHEET
Ya. A. Klyachko, T. A. Izmanova, and Ye. M. Chistyakova *In its* Soviet Sheet Rolling Technol. 10 Mar. 1964 p 11–14 Transl. into ENGLISH from Zavodsk. Lab. (Moscow), v. 29, no. 8, Aug. 1963 p 923–924 (See N64-17021 09-17) OTS: $0.50

Methods for the analysis of sheet molybdenum for gas content were investigated. To remove the moisture and adsorbed gases, the sample was heated to 250° C in a special branch piece of a vacuum-fusion apparatus. In gaseous mixtures, hydrocarbons are found that are formed as a result of the reaction of molybdenum carbides and water vapors. R.T.K.

N64-17065 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPARATUS FOR STUDYING THE KINETICS OF OXIDATION IN METALS
P. M. Arzhanyi and N. N. Velichenko *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 643–646 (See N64-17026 09-18)

Described is an apparatus for studying the kinetics of oxidation in metals, which automatically records weight variations while the specimens are still in the furnace. The apparatus consists of three major parts: the heating surface, a balance containing a photoelement, and the automatic recording instruments. In order to eliminate the influence of the furnace heat on the balance and to reduce convection currents, asbestos and testolite shields are placed between the platform containing the balance and the furnace. P.V.E.

N64-17069 Air Force Systems Command, Wright-Patterson AFB Ohio Foreign Technology Div.
THE ROLE OF NITROGEN IN HIGH-TEMPERATURE OXIDATION OF CHROMIUM IN AIR

V. I. Arkharov, V. N. Konev, I. Sh. Trakhtenberg, and S. V. Shumila *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 675–685 refs (See N64-17026 09-18)

The scale forming on chromium during oxidation in oxygen at 700° to 1000° C is composed of the normal oxide α-Cr_2O_3; no other phase is detected in the scale by X-ray analysis. The scale on chromium oxidized in air in the temperature range 700° to 1000° C has two layers—an outer layer consisting of the rhombohedral oxide α-Cr_2O_3 with a parameter greater than the normal value and an inner layer consisting of the hexagonal chromium nitride Cr_2N. The greater value of the Cr_2O_3 lattice parameter in the scale on chromium oxidized in air can be explained by the fact that the nitrogen dissolves in the chromium oxide. The scaling rate on chromium in air is lower than in oxygen (160 mm Hg). Author

N64-17070 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STUDY OF REACTION DIFFUSION IN A CHROMIUM-NITROGEN SYSTEM

V. I. Arkharov, V. N. Konev, and A. Z. Men'shikov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 686–697 refs (See N64-17026 09-18)

Conclusions resulting from an investigation of the nitriding of chromium in an atmosphere of ammonia include the following: (1) Reaction diffusion in chromium–nitrogen system takes place at an appreciable rate at 700° C and obeys a parabolic time law over the whole temperature range studied (up to 1,200° C). (2) When the temperature rises, the diffusion rate in the chromium–nitrogen system at first increases slowly (below 1,030° C), and then (above 1,030° C) it becomes rapid. (3) Below 1,030° C nitriding produces two layers on the chromium—an inner, thicker layer of Cr_2N and an outer, thinner layer of CrN. (4) No porosity, loosening, or separation is observed on the boundary between the Cr_2N layer and the chromium metal. (5) All the structural characteristics of nitride layers indicate that during reaction diffusion in the chromium–nitrogen system, the nitrogen diffuses into the metal from the outside through the nitride layers and that there is no appreciable diffusion at all of the metal in the opposite direction. P.V.E.

N64-17125 New York U., N.Y. School of Engineering and Science

INVESTIGATION OF THE PREPARATION OF HIGH PURITY METALS VIA THE DECOMPOSITION OF CYCLOPENTADIENYL AND ARENE π-COMPLEX COMPOUNDS Scientific Report No. 2, Nov. 1, 1962-Oct. 31, 1963

Minoru Tsutsui and Charles J. Marsel 31 Oct. 1963 28 p refs (Contract AF 19(628)-1685)
(AFCRL-63-537; AD-431687)

A literature survey on the use of organometallic compounds in the preparation of pure metals suggested that arene π-complexes of the transition elements would be the most favorable type of compounds to investigate. Preliminary work on the thermal decomposition of dibenzenechromium (0) has suggested that chromium metal can be obtained that is free of contamination from carbon. However, the formation of chromium films makes it difficult to remove from glass substrates. Some recent experiments on the deposition of chromium on tantalum sheet have been unsuccessful but are continuing. All experiments to prepare pure organoeuropium compounds have so far been unsuccessful. These included attempts to prepare the tricyclopentadienyl, methylcyclopentadienyl, phenyl, mesityl, methyl, and pentafluorophenyl derivatives. Although tricyclopentadienyl samarium can be prepared, attempts at the preparation of trimesityl and tripentafluorophenyl samarium were not successful. Author

N64-17255 Oak Ridge National Lab., Tenn. Chemical Technology Div.

EVALUATION OF AN ENGINEERING DEMONSTRATION OF THE MODIFIED ZIRFLEX AND NEUFLEX PROCESSES FOR THE PREPARATION OF SOLVENT EXTRACTION FEEDS FROM UNIRRADIATED ZIRCONIUM-BASE REACTOR FUELS

F. G. Kitts Mar. 1964 65 p refs
(Contract W-7405-ENG-26)
(ORNL-3465) OTS: $1.75

In order to recover uranium from zirconium-base reactor fuels by solvent extraction, the metallic fuel and cladding must first be dissolved and a suitable feed solution prepared. Such preparations of solvent extraction feeds were successfully accomplished by using both Modified Zirflex and Neuflex processes, employing an NH_4F-oxidant mixture to dissolve the fuel elements, and HNO_3-$Al(NO_3)_3$ and H_2O additions to adjust the feed. (The HNO_3-$Al(NO_3)_3$ mixture is used to adjust the Modified Zirflex feed, and H_2O to adjust the Neuflex feed.) In both processes the F:Zr charge ratio, initial surface condition, and maximum section thickness of the fuel element were the principal determinants of total dissolution time. The zirconium loading as determined by the free fluoride–zirconium solubility relationship limited the capacity of fuels containing less than 2% U, whereas the free-fluoride-to-uranium ratio of about 100, required for solution stability, was the limiting factor with alloys containing higher percentages of uranium. Hydrogen peroxide concentration was not an important factor in solution stability; the role of ammonia or NH_4OH was not studied. Author

N64-17268 Sandia Corp., Albuquerque, N. Mex. Industrial Hygiene Lab.

CHEMICAL AND RADIOCHEMICAL ANALYTICAL PROCEDURES

R. J. Everett, L. W. Brewer, G. W. Edwards, A. J. Jack, T. A. Linn, Jr. et al Feb. 1964 67 p refs
(SC-4783(RR)) OTS: $2.00

The chemical procedures reported are for the determination of: (1) acid and alkali contaminants in air; (2) benzene, toluene, and other aromatics in air; (3) beryllium; (4) cadmium in air and in urine; (5) lead in air, swipes, and urine; (6) mercury in urine; (7) composition of organic solvents; (8) thallium in air and in urine; (9) trichloroacetic acid in urine; (10) uranium; and (11) zinc in air. Radiochemical procedures are given for the following: (1) gross beta activity in soil, urine, vegetation, and water; (2) cesium^{137} in soil, urine, vegetation, and water; (3) plutonium in urine; (4) polonium^{210} in urine; (5) sodium^{24} in air, blood, urine, and water; (6) strontium^{90} in soil, vegetation, and water; (7) tritium in urine and in water; and (8) enriched uranium in urine. R.T.K.

N64-17345 Joint Publications Research Service, Washington, D.C.

HIGH TEMPERATURE DECOMPOSITION OF BORON PHOSPHIDE

Chao P'eng-nien and Mo Chin-chi *In its* Transl. on Communist China's Sci. and Technol. No. 75 19 Mar. 1964 p 48–56 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 11, 1963 p 53–55 (See N64-17342 09-01) OTS: $2.25

The carrier method was utilized to determine the thermal decomposition pressure of boron phosphide, using purified hydrogen gas as the carrier. The temperature range for the determination of the thermal decomposition pressure was 1,000° to 1,100° C. Hydrogen flow speed was in the range of 0 to 50 ml/min. The average molecular weight of the phosphorus vapor, at different temperatures, was calculated, and

this average was used to determine the balanced decomposition pressure of the thermal decomposition of boron phosphide by Van Wazer's method. Results are given. I.v.L.

N64-17347 Joint Publications Research Service, Washington, D.C.
MATHEMATICAL MODELS OF MATERIAL TRANSPORT
Ch'en Min-heng, Yuen Wei-k'ang, and Ch'en Liang-heng *In its* Transl. on Communist China's Sci. and Technol. No. 75 19 Mar. 1964 p 71–77 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 11, 1963 p 51–53 (See N64-17342 09-01)

The relation between the parameters of a mathematical model of material transport in chemical equipment, and of the numerical characteristics of residence-time distribution is derived. I.v.L.

N64-17369 Kentucky U., Lexington
TRACE ELEMENT DETERMINATIONS IN NATURAL MATERIALS BY ACTIVATION ANALYSIS
William D. Ehmann [1963] 22 p refs Presented at the 19th Intern. Congr. of Pure and Appl. Chem., London, 10–17 Jul. 1963
(Contract AT (40-1)-2670)
(U/50/50)

Abundances of zirconium, hafnium, cadmium, antimony, tantalum, gold, platinum, and iridium have been determined in meteorites, tektites, deep-sea sediments, and various terrestrial materials by use of neutron activation analysis. Each of these elements, except platinum, is separated after irradiation from the sample matrices by use of carriers and specific radiochemical separation techniques. Gold and platinum are determined simultaneously by separating and counting only gold. This is possible due to the decay of the irradiation-produced Pt^{199} to its radioactive daughter, Au^{199}. All abundances are computed by comparison of gamma-ray counting rates of the extracted samples with the counting rates of standard samples of each element irradiated simultaneously. Author

N64-17460 Aberdeen Proving Ground, Md. Coating and Chemical Lab.
AN ABBREVIATION OF A QUANTITATIVE INFRA-RED METHOD FOR NITROCELLULOSE AND ITS APPLICATION TO ALKYD-NITROCELLULOSE LACQUERS
M. L. Adams 10 Jan. 1964 12 p refs
(CCL-154; AD-432592) OTS: $0.50

Using the infrared absorption band at 11.8μ, nitrocellulose is determined in acetone solutions of air-dried alkyd-nitrocellulose lacquer vehicle films, without separation of nitrocellulose and without interference due to the color of the films. Author

N64-17461 Aberdeen Proving Ground, Md. Coating and Chemical Lab.
APPLICATION OF PYROLYTIC GAS CHROMATOGRAPHY TO THE ANALYSIS OF THERMOSETTING ACRYLIC COATING RESINS
George G. Esposito 4 Feb. 1964 21 p refs
(CCL-157; AD-432590) OTS: $0.75

This investigation was conducted to determine the applicability of pyrolytic gas chromatography to the analysis of thermosetting acrylic resins. Primary interest is in the hydroxy functional thermosetting acrylic resins, particularly those prepared from hydroxy ethyl methacrylate and hydroxy propyl methacrylate. The identification of all the major components is possible in a relatively short period of time using minimal samples. The degradation products from the pyrolysis of the resinous material occur in the helium stream and are separated and identified on polar and nonpolar columns. Author

N64-17479 Colorado U., Boulder
THE SYNTHESIS OF SPECIAL FLUORINE-CONTAINING MONOMERS Quarterly Report No. 8, 1 Jul.–1 Oct. 1963
J. D. Park and J. R. Lacher 20 Oct. 1963 30 p
(Contract DA-19-129-QM-1926)
(AD-432978) OTS: $2.60

A summary of current progress in the various research programs is presented. The areas of research include: synthesis of new olefins and diolefins; preparation of fluorinated carbocyclic and heterocyclic three-membered rings; preparation of "dibox" compounds--(1-vinyl-2,3,3-trifluorocyclobutane $\xrightarrow{CF_2 = CFCl}$ 1-(2,3,3-trifluoro-1-cyclobutenyl)-2-chloro-2,3,3-trifluorocyclobutane $\xrightarrow{-HCl}$ bis(2,3,3-trifluorocyclobutenyl); synthesis of cyclic imines; and preparation of various fluorinated dienes. P.V.E.

N64-17480 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
SYNTHESIS OF POLYORGANOALUMINOSILOXANES REACTION OF DOUBLE DECOMPOSITION OF SODIUM SALTS, ALKYLSILANETRIOLS AND ALUMINUM CHLORIDE
K. A. Andrianov and A. A. Zhdanov 14 Feb. 1964 10 p Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 114, 1957 p 1005–1007
(RSIC-134; AD-431240)

The interaction of the sodium salts of alkylsilanetriols with aluminum chloride was investigated. The sodium salt of phenylsilanetriol, which was formed by the alkali hydrolysis of phenyltrichlorosilane, reacted with aluminum chloride to form a hard, brittle resin, soluble in organic solvents, and 3.41 g of sodium chloride. Found in % were: Si 18.35%; Al 7.27%. For a ploymer with an elementary group of the formula $[C_6H_5Si(O)O]_3Al$, Si and Al were calculated as 19.20% and 6.15%, respectively. The sodium salt of ethylsilanetriol, which was formed by the alkali hydrolysis of ethyltrichlorosilane, reacted with aluminum chloride to form a colorless, brittle resin, soluble in organic solvents, and 7.58 g of sodium chloride. Found in % were: C 24.45%; H 5.79%; Si 27.43%; and Al 8.68%. For a polymer with an elementary group of the formula $[C_2H_5Si(O)O]_3Al$, C, H, Si, and Al were calculated as 24.48%; 5.14%; 28.60%; and 9.18%, respectively. I.v.L.

N64-17528 Atomic Energy Commission, Washington, D.C.
HANDBOOK ON AEROSOLS
1963 152 p refs Reissue of 11 chapters from "Sum. Tech. Rept. of Div. 10", Natl. Defense Res. Comm., 1950
(STR-10-1(Excerpts)) OTS: $2.75

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N64-17542 European Atomic Energy Community, Brussels (Belgium)

RESEARCH ON THE PREPARATION AND CONSERVATION OF TRITIATED STEROIDS WITH HIGH SPECIFIC ACTIVITY [RECHERCHES SUR LA PREPARATION ET LA CONSERVATION DES STEROIDES TRITIES D'ACTIVITE SPECIFIQUE ELEVEE]

P. Osinski Inst. Interuniv. des Sci. Nucl., [Dec.] 1963 13 p refs In FRENCH; ENGLISH summary
(Contract EURATOM 012-61-8 RISB)
(EUR-412.f) Available from Belgian-American Bank and Trust Co., N.Y., account no. 121.86: 40 Belg. Fr.

Study of the synthesis of 3 artificial steroids by dehydrogenation with selenium dioxide has shown that the yield is increased by a factor of between 2.5 and 4 by doubling the quantity of the catalyst. The maximum possible specific activity is equal to 1/3 of the activity incorporated at the time of hydrogenation, i.e., 40 C/mM. The decrease in specific activity is due to the loss of the isotope during dehydrogenation. A study has been carried out on the synthesis of 3 natural corticosteroids by enzymatic reduction or chemical reduction. The storage behavior of cortisol-1,2-H^3 and of corticosterone-1,2-H^3 having high specific activities shows that there are two self-irradiation destruction mechanisms according to the type of solvent. The organic solvents make for the formation of impurities of polarities similar to the starting substance. Water promotes the formation of a polar fraction. Good storage is insured by the use of a cyclical solvent of little reactivity at low temperature. Author

N64-17562* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

DETERMINATION OF OXYGEN IN POTASSIUM

William A. Dupraw et al Repr. from Anal. Chem. v. 36, Feb. 1964 p 430–431 refs
(NASA RP-142)

An improvement in the Pepkowitz–Judd amalgamation technique for determining the oxygen content of potassium is reported. The five innovations that result in greater precision and reproducibility are: (1) maintaining the entire system complex under a high vacuum (between 2×10^{-3} and 4×10^{-4} torr); (2) using a small amalgam system volume; (3) using a ball check valve to contain the amalgamation reaction; (4) replacing greased or waxed joints with flanged O-ring joints; and (5) taking replicate samples from a single sample tube. No dependence upon amalgam residence time in the glass extraction tube was found, but a poor vacuum was shown to be a source of positive error. M.P.G.

N64-17595 Victoria U., Wellington (New Zealand)

FURTHER ORGANIC CONSTITUENTS OF FILTERED LAKE WATERS

Michael H. Briggs Repr. from Life Sci. no. 11, 1962 p 649–651 refs
(Sponsored by New Zealand U.)

Residues prepared from New Zealand lake-water samples by evaporation under reduced pressure were extracted with ethyl acetate to determine the major organic constituents. Data are presented indicating that the ethyl acetate extracts are largely the hydroxycarboxylic acids previously detected by Shapiro in North American lakes. Minor organic constituents detected in the original residues, by various methods, include volatile fatty acids, keto acids, and urea and ureides. M.P.G.

N64-17656 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

THE QUANTITATIVE X-RAY FLUORESCENCE ANALYTICAL DETERMINATION OF POTASSIUM, RUBIDIUM, STRONTIUM, BARIUM, TITANIUM, ZIRCONIUM AND PHOSPHORUS

Paula Hahn-Weinheimer and Helmuth Ackermann 25 Feb. 1964 24 p refs Transl. into ENGLISH from Z. anal. Chem. (Berlin), v. 194, 1963 p 81–101
(RSIC-137; AD-432307)

In Malsburg granite (a geologically independent granite pluton in the Southwestern Black Forest), the local heterogeneity of the elements potassium, rubidium, titanium, zirconium, phosphorus, strontium, and barium have been determined by means of X-ray fluorescence analysis, in an attempt to determine, subsequently, the heterogeneity of the entire body of rocks. The results of the analyses are reproducible when the stone is ground to a size $< 37\mu$ after a systematic collection of samples. The counting statistical, instrumental, and preparatory errors have been determined. The results indicate that the error found for 95 percent probability is consistently smaller than the distribution of the elements in a quarry or in the entire granite body. Author

N64-17658 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

SOME N-SUBSTITUTED DIMETHYL-DIAMINO-SILANES AND RELATED COMPOUNDS

Erik Larsson and Bengt Smith 25 Feb. 1964 10 p refs Transl. into ENGLISH from Acta Chem. Scand. (Munksgaard), v. 3, 1949, p 487–492
(RSIC-139; AD-432289)

Some compounds of the general formula $(CH_3)_2Si(NH \cdot R)_2$, with R = $-CH_3$, $-CH_2 \cdot CH_3$, $-(CH_2)_6CH_3$, $-C_6H_5$, $-CH_2 \cdot C_6H_5$, have been prepared. In addition, the cyclic compound $[(CH_3)_2Si \cdot N \cdot C_6H_5]_3$ has been obtained in a small quantity. Author

N64-17667 California U., Livermore. Lawrence Radiation Lab.

A MANOMETRIC METHOD FOR THE DETERMINATION OF OXYGEN IN ORGANIC COMPOUNDS

Jack W. Frazer 17 Dec. 1963 14 p refs
(Contract W-7405-ENG-48)
(UCRL-7618) OTS: $0.50

A vacuum analytical method for the determination of oxygen in organic compounds has been developed. Several milligrams (usually 3 to 5 mg) of the organic to be analyzed are sealed in an evacuated quartz bomb along with 2.5 to 3.5 mg of an organic reducing agent. The bomb is fired at 1050° to 1055° C for 30 min or longer. At the end of the heating period the bomb temperature is rapidly lowered from 1055° to < 650° C. As a last step the gaseous products are removed from the bomb, and the volumes of CO and H_2 are determined. From

these values the percentage of oxygen can be calculated providing an appropriate blank is obtained. Compounds containing carbon, hydrogen, nitrogen, sulfur, iodine, and chlorine have been successfully analyzed for oxygen. Author

N64-17732 Union Carbide Nuclear Co., Tuxedo, N.Y. Research Center
RESEARCH IN ACTIVATION ANALYSIS Final Report, 23 Apr. 1962-31 Jul. 1963
Henry H. Kramer, Victor J. Molinski, Roy S. Tilbury, Werner H. Wahl, and Paul M. Stier Washington, AEC Div. of Tech. Inform., 30 Sep. 1963 99 p refs
(Contract AT(30-1)-2975)
(NYO-10174) OTS: $2.25

The current program status includes the following: (1) A rapid chemical procedure has been developed for the radiochemical isolation of 2.3-minute Al^{28} from neutron-irradiated samples of ore materials. (2) Titanium has been analyzed in a variety of materials by neutron-activation analysis, using a rapid radiochemical procedure to isolate 5.8-minute Ti^{51}. (3) A procedure, using N-benzoylphenylhydroxylamine as the complexing agent, has been developed for the rapid radiochemical separation of 3.77-minute V^{52}. (4) Samples of neutron-activated ores have been analyzed for Nb, using a rapid, radiochemical separation procedure to isolate 6.6-minute Nb^{94m}. (5) A rapid procedure for the radiochemical separation of 14.6-minute Mo^{101} was developed that uses an ethyl acetate extraction of the molybdenum thiocyanate complex. (6) Metastable isomers of stable isotopes may be formed in the nuclear reactor by inelastic neutron scattering and photoexcitation of the stable isotopes, and by radiative neutron capture and (n,2n) reactions on neighboring isotopes. (7) Studies of the formation of 67-minute Pb^{204m} have shown that this isomer will become an important indicator for the activation analysis of samples irradiated with a reactor neutron spectrum. (7) The reactor neutron-activation cross section for $W^{184}(n,\gamma)W^{185m}$ was determined to be between 1 and 2 mb, by the use of a sample of 94.3% enrichment. I.v.L.

N64-17803 Bureau of Mines, Albany, Ore. Albany Metallurgy Research Center
INVESTIGATION OF CHLORINATION REACTIONS USING CARBON^{14}
Robert R. Brown, F. E. Block, and A. W. Henderson 1964 24 p refs
(BM-RI-6402)

The chlorination of Cr_2O_3 (chromic oxide) in the presence of carbon, with CCl_4 (carbon tetrachloride) and $COCl_2$ (phosgene) chlorinating agents, was investigated by employing the radioactive tracer carbon^{14}. By tagging carbon mixed with Cr_2O_3, the chlorination reaction was evaluated in terms of the competitive reaction of the elemental carbon and the carbon contained by the chlorinating agent. A unique gas-analysis train was used to separate the chlorination product gases—CO, CO_2, and $COCl_2$. The C^{14} activity of the gases was determined and used to calculate the reactivity of each source of carbon. Reactivities were determined for the temperature range from 600° to 900° C. The results of the investigation show that each source of carbon reacts significantly with the Cr_2O_3 and that the reactivity of each form of carbon depends on the reaction temperature, and each form is independent of the other. Radioisotope and gas-analysis techniques are discussed, and a description of the experimental apparatus is given. Author

N64-17824 Iowa State U. of Science and Tech., Ames Ames Lab.
PREPARATION AND REACTIONS OF SOME LOWER TUNGSTEN HALIDES AND HALIDE COMPLEXES
Theodore Martin Brown and Robert Mc Carley Nov. 1963 117 p refs
(Contract W-7405-ENG-82)
(IS-741) OTS: $2.50

The current program status includes the following: (1) A method for the preparation of the tungsten (IV) halides, WCl_4 and WBr_4, by the aluminum reduction of WCl_6 and WBr_5, respectively, has been developed. (2) The first simple trihalide, WBr_3, was prepared by reacting WBr_2 with liquid bromine. (3) A convenient synthesis of high purity WCl_2 and WBr_2 results from the disproportionation of WCl_4 and WBr_4, respectively, at 450° and 500° C. (4) Tetrahalodi(pyridine)tungsten(IV) complexes were prepared from the reactions of the pure tetrahalides with pyridine and from the reduction of WCl_6 and WBr_5 with pyridine. The tungsten(IV) halides were found to be good coordinating agents. (5) Studies to help elucidate the structure of the pyridine adducts were carried out with the aid of conductance, spectral, and magnetic susceptibility measurements. The complexes are paramagnetic and have moments much lower than the spin-only value for two electrons. Solution studies of these complexes in pyridine, by conductance and absorption spectra techniques, indicated the existence of two species, probably the cis or trans isomer along with the ion, $(W(C_5H_5N)_3Cl_3)^+$, in solution. The spectra of these solutions show intense bands in the visible region, which have been attributed to charge-transfer transitions. I.v.L.

N64-17839 Phillips Petroleum Co., Bartlesville, Okla.
POLYPHENYL ANALYSIS
P. W. Solomon Idaho Falls, Idaho, National Reactor Testing Station, 31 Mar. 1964 146 p refs
(Contract AT(10-1)-1080)
(IDO-16912) OTS: $2.50

Inorganic salts on inert supports have been investigated as column packings in gas chromatographic separations of organic compounds. These packings have proved highly satisfactory for separating polyphenyls from biphenyl through p-hexaphenyl. The following salts have been found to give good separations of polyphenyls: LiCl, CsCl, $SrCl_2$, $CaCl_2$, K_3PO_4, and certain mixtures of these. They were satisfactory for both qualitative and quantitative analyses. Other types of organic compounds besides polyphenyls, such as fused-ring aromatic, aralkyl, and aliphatic hydrocarbons, aromatic amines, nitro compounds, haloaromatics, aromatic ketones, and quinones were satisfactorily separated. Lithium chloride columns (1-in. diameter) were successfully used for preparatory scale work. Hexaphenyls produced by electron irradiation of pure o-, m-, and p-terphenyl have been isolated and characterized by means of these inorganic salt columns. Author

N64-17840 Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
THE DESIGN OF A DYNAMIC CORROSION AND CHEMICAL CONTROL TEST LOOP AND PRELIMINARY OUT-OF-PILE TEST RESULTS
William F. Zelezny, ed. Natl. Reactor Testing Sta., 12 Jul. 1963 93 p refs
(Contract AT(10-1)-205)
(IDO-16812) OTS: $2.00

A project having the objective of developing and demonstrating in actual operation a system for the chemical control of nuclear reactors has been carried to partial completion. The design developed by this project embodies a circulating loop in the ETR, replacing one of the conventional mechanical control rods. Control of the reactor is to be effected by varying the concentration of a boric acid solution circulating through the loop. A second objective of the project is the

performance of long-term corrosion tests on boric acid–aluminum alloy combinations. This report describes the overall loop design and the means by which this design was developed. These include critical facility measurements, analog computer calculations, hydraulic and heat-transfer computations, and the construction and operation of an out-of-pile mockup loop to determine the dynamic characteristics of the loop. Author

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-16930* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME EXPERIMENTAL RESULTS FOR A DOPPLER TRACKING METHOD USING A SIMPLE CW BEACON
Allen B. Henning Washington, NASA, Mar. 1964 23 p refs (NASA TN D-2188) OTS: $0.75

The results of an experimental Doppler tracking system incorporating a simple CW beacon transmitter in the vehicle and four ground receiving stations are presented. This system was used on some Trailblazer I reentry physics research vehicles. A three-station solution was used to obtain the trajectory quantities that were not available by any other method. The data for the four-station solution were compared with available radar data. Satisfactory trajectory data using the three-station solution can be obtained, but large errors are possible due to transmission frequency shifts. The four-station solution is independent of transmitter frequency changes and with accurate data receivers can give good results. Author

N64-16942 Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
SATELLITE TELEMETRY OF OCEANOGRAPHIC OBSERVATIONS
George E. O'Rourke [1964] 22 p refs For presentation at the 1964 Natl. Telemetering Conf., Los Angeles, 2–4 Jun. 1964

Buoys have recorded observational data on a storage medium, usually film, for retrieval when the buoy is visited by its tender. The data have been processed ashore as much as a year or more after the period of reference. Therefore, there is a need for a reliable and economical telemetry system. A satellite-based system for tracking and recovering oceanographic data is proposed. In order to determine whether a satellite system will be economical for oceanographic telemetry, a brief review of the costs and problems associated with competitive oceanographic telemetry systems is presented. The results of the economic evaluation indicate that a satellite position-finding and telemetry system for oceanographic use would provide a substantial advantage over existing telemetry systems, and would be economically justified if a fairly extensive and geographically dispersed buoy network is used. R.T.K.

N64-16974 Naval Research Lab., Washington, D.C. Communications Branch Radio Div.
THE LIGHTWEIGHT TRANSOSONDE SYSTEM
J. W. Allen and G. Welch 30 Jan. 1964 140 p refs (NRL-5921; AD-431799)

A new lightweight transosonde airborne system has been developed. The new system consists of a lightweight plastic balloon and two small (1 ft^3) instrument packages. The balloon is a pressurized sphere (12.5-ft diameter) made of 0.002-in.-thick Mylar plastic. It weighs approximately 20 lb and will withstand 50 to 60 mb internal pressure. The instrumentation consists of: (1) a dual-frequency crystal-controlled 30-w high-frequency transmitter; (2) a power supply consisting of a battery made up of silver zinc cells supplying the low d.c. voltage (7.5), and a d.c.-to-d.c. converter supplying the high voltage (300 v, 600 v); and (3) a Morse code encoder and appropriate meteorological sensors (ambient pressure, ambient temperature, and balloon internal pressure). Author

N64-17194* Maryland U., College Park
PROCEEDINGS OF THE SPACE COMMUNICATIONS INSTITUTE, MARYLAND U., COLLEGE PARK, JUNE 23–28, 1963
1963 110 p refs Proc. conducted in cooperation with NASA (NASA Grant NsG-482)
(NASA CR-53170) OTS: $9.10 ph, $3.50 mf

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3. PROBLEMS OF WAVE PROPAGATION F. J. Tischer (Ala. U. Res. Inst.) p 36–50 refs (See N64-17197 09-20)
4. EARTH ENVIRONMENT EFFECTS S. F. Singer (Weather Bur.) p 52–63 (See N64-17198 09-12)
5. QUANTUM ELECTRONICS AND COMMUNICATION J. P. Gordon (California U.) p 65–72 refs (See N64-17199 09-08)
6. SPECIALIZED TOPICS III, DECISION PROCESSES IN COMMUNICATION THEORY D. Middleton (Middleton (David)) p 74–76 refs (See N64-17200 09-08)
7. SPECIALIZED TOPICS IV, MILLIMETER WAVES D. D. King (Electronics Communications, Inc.) p 78–92 refs (See N64-17201 09-09)
8. PLASMA WAVES (CMA DIAGRAM) W. M. Hooke (Princeton U.) p 93–101 refs (See N64-17202 09-24)

N64-17196 New York U., N.Y.
CODING, FILTERING, AND INFORMATION THEORY
Leonard S. Schwartz *In* Md. U. Proc. of the Space Communications Inst., Md. U., College Park, Jun. 23–28, 1963 1963 p15–35 refs (See N64-17194 09-08) OTS: $9.10 ph, $3.50 mf

The present-day theory of communications, as a statistical problem, is largely the work of two men, Claude Shannon and Norbert Wiener. Shannon's theory basically is one of coding; it presents the method in which to organize a message at the transmitter—within certain limits of power, bandwidth, and time—in order to resist the corrupting effect of channel noise. Wiener's theory, basically, is one of filtering, and presents the method of recovering—within limits imposed on the same parameters—a noise-corrupted signal at the receiver. The purpose of several recent developments in the field of digital communications is reliability improvement, particularly as related to the method of decision in the receiver, and the

introduction of a feedback channel between the receiver and the transmitter. These methods represent additional means for coping with the reliability problem in communications. The use of feedback in the case of accept–reject information returned to the transmitter, by means of a signal constructed solely for this purpose, as well as in the case of two-way communications is discussed. I.v.L.

N64-17199 California U., San Diego
QUANTUM ELECTRONICS AND COMMUNICATION
James P. Gordon *In* Md. U. Proc. of the Space Communications Inst., Md. U., College Park, Jun. 23–28, 1963 1963 p 65–72 refs (See N64-17194 09-08) OTS: $9.10 ph, $3.50 mf

Entropy is a measure of the randomness of the disposition of the parts that make up a physical system. Information (or more precisely, capacity) is the same measure of an apparent randomness that is, however, controlled by a transmitter and interpretable by a receiver. The most important information that can be incorporated in a physical system is, in fact, its total entropy less that part of the entropy that is either uncontrollable or uninterpretable. The uncontrollable randomness of the physical system is usually thought of as noise. In addition, quantum-mechanical limitations on measuring processes by receivers introduce further restrictions on the information that can be important but is often not easy to assess. These ideas are applied to a basic communication system that consists of a transmitter, a transmission medium, and a receiver. I.v.L.

N64-17200 Middleton (David), Concord, Mass.
DECISION PROCESSES IN COMMUNICATION THEORY
David Middleton *In* Md. U. Proc. of the Space Communications Inst., Md. U., College Park, Jun. 23–28, 1963 1963 p 74–76 refs (See N64-17194 09-08) OTS: $9.10 ph, $3.50 mf

Two principal classes of decision, $\underline{\gamma}$, are distinguished: (a) signal detection—here $\underline{\gamma} = \underline{\gamma}_1$: "yes," a signal is present or $\underline{\gamma} = \underline{\gamma}_0$: "no," only noise occurs, and $\underline{\gamma} = (\underline{\gamma}_0, \underline{\gamma}_1)$: (b) signal extraction—this is a measurement process, in which "how much" is asked—the magnitude of S, or its waveform is desired. Detection is recognized as the communication equivalent of hypothesis testing in statistical theory, whereas extraction is the counterpart of statistical estimation. System structure is embodied in the decision rule, $\delta(\underline{\gamma}|\,V)$ = probability, or probability density of the decision $\underline{\gamma}$, given the data V. For optimum systems, $\delta \to \delta^*$ is sought, which minimizes the average risk, e.g., $R = R^*$. A variety of maxima are possible. In detection, δ is a probability, and $C(S,\underline{\gamma})$ can be represented as a matrix of preassigned (constant) costs. For extraction, on the other hand, δ is a probability density, and the cost function becomes a more suitable function of the decision δ and the quantity being "extracted," or estimated. I.v.L.

N64-17229 Collins Radio Co., Cedar Rapids, Iowa
VOR, DUAL-SIDEBAND EQUIPMENT Final Report
W. Follensbee and R. Lutz Dec. 1963 89 p
(Contract FAA/BRD-404)
(CER-1669A)

The FAA/BRD-404 dual-sideband Doppler VOR system consists of a dual-sideband VHF transmitter and dual-rotor distributor developed for use with the FAA Doppler VOR ground station. The dual-sideband transmitter consists of a sideband generator that is frequency- and phase-locked to a carrier transmitter, sideband amplifiers, and power amplifiers. The output of the sideband transmitter is 100 watts per sideband. The dual-rotor distributor is a capacity-type distributor that switches the 2 sideband inputs to 50 antenna outputs. The sideband inputs are fed simultaneously to opposite antenna outputs. Opposite sideband suppression is 30 db, and carrier suppression is 40 db at the output. Adjacent antenna output isolation is 30 db, and isolation to the remaining antenna outputs are 50 db or more. The use of a dual-sideband system in the Doppler VOR ground system is possible and should show improvement over a single-sideband system.
Author

N64-17271 Gt. Brit. Dept. of Scientific and Industrial Research Radio Research Station
LIST OF OPTICAL OBSERVATIONS OF SATELLITES MADE FROM U.K., EUROPE AND MALTA, OCTOBER 1963
[1963] 18 p

Optical observations of the following satellites are listed: 1960 eta 1; 1960 eta 3; 1960 epsilon 3; 1960 gamma 2; 1961 rho 1; 1961 rho 2; 1961 alpha delta 1; 1961 delta 1; 1961 sigma 1; 1962 beta alpha 1; 1962 beta alpha 2; 1962 beta mu 1; 1962 beta mu 2; 1962 beta tau 6; 1962 beta theta 1; 1962 kappa 1; 1962 alpha upsilon 1; 1962 beta kappa 1; 1962 alpha omicron 4; 1963-17G; 1963-17A; 1963-26A; 1963-24A; 1963-24B; 1963-33A; 1963-33B; 1963-35A; 1963-30A; 1963-14A; 1963-38A; 1963-38B; and 1963-38C. I.v.L.

N64-17272 Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station
LIST OF OPTICAL OBSERVATIONS OF SATELLITES MADE FROM U.K., EUROPE AND MALTA, NOVEMBER 1963
[1963] 19 p

Optical observations of the following satellites are listed: 1960 beta 2; 1960 epsilon 3; 1960 gamma 2; 1960 eta 1; 1960 eta 3; 1961 omicron 1; 1961 omicron 2; 1961 delta 1; 1961 alpha delta 1; 1961 sigma 1; 1962 beta 1; 1962 kappa 1; 1962 omicron 1; 1962 omicron 2; 1962 alpha upsilon 1; 1962 beta alpha 1; 1962 beta alpha 2; 1962 beta kappa 1; 1962 beta chi 1; 1962 alpha psi 1; 1962 beta theta 1; 1962 alpha psi 2; 1963-33B; 1963-33A; 1963-14A; 1963-17G; 1963-26A; 1963-27A; 1963-43A; 1963-09A; 1963-30A; and 1963-43D. I.v.L.

N64-17273 Gt. Brit. Dept. of Scientific and Industrial Research. Radio Research Station
LIST OF KINETHEODOLITE OBSERVATIONS OF SATELLITES MADE FROM U.K., APRIL, MAY AND JUNE 1963
[1963] 17 p

Kinetheodolite observations of the following satellites are listed: 1961 alpha 1; 1961 sigma 1; 1962 kappa 1; 1962 alpha upsilon 1; 1962 beta chi 1; 1963-3A; and 1963-9A. I.v.L.

N64-17287 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
PRELIMINARY DESCRIPTION OF THE EDL-R7 RECEIVING SYSTEM
Ronald G. Brown 14 Oct. 1963 24 p
(Contract DA-36-039-AMC-00088(E))
(EDL-G200; AD-431891)

The EDL-R7 receiving system is a channelized, superheterodyne receiving system capable of search and monitor functions for AM, FM, pulse, and CW signals. Multiple combinations of electronic search and manual monitor tuners can be provided, each capable of independent operation from 250 Mc to 12 Gc. The system can be operated from one or more antennas, which can be remotely located if sufficient preamplification is used to overcome transmission line losses. A major

feature of the system is its flexibility. It is capable of providing electronic search over wide frequency bands, while simultaneously concentrating multiple tuners (search and/or monitor) in any specific frequency band or bands of high signal density. Furthermore, additional search and/or monitor tuners may be added, or the ratio of search to monitor tuners changed, without system redesign. Typical performance figures include an 8- to 15-db noise figure and a 55- to 60-db dynamic range. I.v.L.

N64-17301 RAND Corp., Santa Monica, Calif.
GRADIENT SCATTERING FROM MISSILE WAKES
R. L. Kirkwood Feb. 1963 24 p refs
(ARPA-SD-79; ARPA Order 189-61)
(RM-3466-ARPA; AD-403769)

An approximate relation for estimating the echoing area of a laminar missile wake is developed from two different points of view. First, the wake is considered as a continuum, and the radar return is determined from the gradient of the refractive index. Next, the wake is considered as a collection of particles, and the return is computed as the sum of the returns from the individual electrons. It is shown that the two results are essentially equivalent. Author

N64-17302 Rome Air Development Center, Griffiss AFB, N.Y.
DIVERSITY RECEPTION OF NONFADING FREQUENCY SHIFT KEYING
Jack K. Wolf Jan. 1964 23 p refs
(RADC-TDR-63-475; AD-431870)

This report considers the theoretical performance of a frequency diversity system used in conjunction with a nonfading communications channel. Both a noncoherent receiver system and a coherent receiver system are considered. The performances of these systems are compared for both manmade and natural interference. Author

N64-17309 Army Missile Command, Huntsville, Ala. ARPA Div.
DESCRIPTION OF A METHOD FOR DETERMINING AZIMUTH AND ELEVATION TRACKING RATES Technical Note No. 2
Frank M. Vann and H. Tracy Jackson, Jr. 23 Sep. 1963 34 p
(Sponsored by ARPA; Proj. Defender)
(TN-AMSMI-RNR-63-2; AD-427758)

An analytical model is discussed, which gives the angular tracking rates required of an instrument that must continuously view a ballistic vehicle reentering the earth's atmosphere. Conversely, it gives the portion of the trajectory over which tracking can be maintained within prescribed maximum angular tracking rates. It is assumed that the fixed instrument location is known with respect to the actual impact point of the vehicle. In addition to computing tracking angles and angular rates, other necessary parameters such as velocity, acceleration, altitude, reentry angle, and slant range are obtained from the program. A list of the FORTRAN programs for a two-degree-of-freedom trajectory and the azimuth and elevation tracking rates for a particular trajectory geometry are included. Author

N64-17318 RAND Corp., Santa Monica, Calif.
RADAR ECHO FROM RE-ENTRY VEHICLES
Herschel Weil May 1963 51 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3251-PR; AD-406204)

This memorandum outlines the main aspects of the problem of computing the radar echo from reentry vehicles, primarily to indicate what types of radar-return estimates can be made using presently available results from the gas dynamic theory of wakes and from electromagnetic theory. Numerical results for low-frequency reflectivities and radar cross sections are obtained for a particular computed reentry wake viewed broadside. The resulting radar cross sections, although orders of magnitude greater than the radar cross section of the vehicle with no wake, are smaller than the broadside geometric cross section of the wake region within which the local plasma frequency is greater than the radar frequency. Author

N64-17360 Aerospace Corp., El Segundo, Calif.
THE INFLUENCE OF RANDOM PHASE ERRORS ON THE EDGE RESPONSE OF SYNTHETIC-APERTURE MAPPING RADAR SYSTEMS
Jean A. Develet, Jr. 4 Mar. 1964 20 p refs
(Contract AF 04(695)-269)
(TDR-269(9990)-4; SSD-TDR-64-26; AD-432843)

The influence of small random phase errors on the edge response of an idealized synthetic-aperture mapping radar is treated. The target field considered is homogeneous rough terrain that suddenly changes reflectivity. The ideal system discussed has gaussian real antenna beams and uses matched filtering to obtain fine azimuth resolution. The measure of system performance is the ensemble average power output. The results in this report can assist in determining the effect of phase errors on the ability of synthetic-aperture mapping radars to discern roads, rivers, ravines, or any terrain features that can be accurately characterized by a sudden change in reflectivity with a fairly homogeneous scattering medium on either side of the demarcation. Author

N64-17362 Navy Electronics Lab., San Diego, Calif.
LINEAR DIGITAL CORRELATOR (DICOR) Research and Development Report [Oct. 1958–Jun. 1963]
M. H. Mott and A. T. Roome 8 Nov. 1963 31 p refs
(NEL-1194; AD-429308)

A linear digital correlator (DICOR) has been built and tested in the laboratory. Its design evolved from investigations of matched filtering of coded-pulse radar signals utilizing digital techniques. DICOR represents an attempt to find an economical means of eliminating or reducing the strong-signal-capture effect, which leads to complexity and high cost in digital matched filters. Laboratory performance of DICOR agreed with theoretical predictions for a seven-element coded signal. The basic DICOR unit is reproducible in large quantities, is of reasonable cost, and uses commonly stocked components. Author

N64-17363 Navy Electronics Lab., San Diego, Calif.
FCT, A NEW SEQUENTIAL DETECTION METHOD FOR MULTIPLE-RESOLUTION-ELEMENT RADAR Research Report [1 Jan.–1 Sep. 1963]
G. M. Dillard 25 Oct. 1963 32 p refs
(NEL-1201; AD-429307)

Simulation of the FCT (forced continuation testing) mode in processing binomially quantized radar-receiver output voltage gave data that agreed well with exact, computed results. The simulation equipment used performed satisfactorily. The FCT mode was compared with fixed sample size methods and with simple parallel testing (SPT). The results indicate that, generally: (1) As the number of resolution elements is increased, a point is reached after which the fixed sample test is a better

procedure than SPT. (2) In many cases FCT is better than both the fixed sample test and SPT. (3) Considerable reduction in error probabilities with only a slight increase in expected sample size can result from the FCT procedure. Author

N64-17371 Lincoln Lab., Mass. Inst. of Tech., Lexington
AN INTRODUCTION TO FEEDBACK DEMODULATION
Harry L. Van Trees 16 Aug. 1963 58 p refs
(Contract AF 19(628)-500)
(Rept. 65G-5; AD-416586)

Two areas are emphasized: (1) the development of models of varying complexity that may be used to study system behavior; and (2) the design of feedback demodulators for the demodulation of large deviation angle-modulated signals. Author

N64-17454 Lincoln Lab., Mass. Inst. of Tech., Lexington
OPTIMUM PULSE TRANSMISSIONS FOR MULTIPATH CHANNELS
John G. Proakis 16 Aug. 1963 40 p refs
(Contract AF 19(628)-500)
(Rept. 64G-3; AD-416639)

The performance of an incoherent M-ary communication system operating via a fluctuating multipath channel is computed under very restrictive conditions on the channel behavior, namely, that the received signal consists of resolvable, independent Rayleigh fading paths, each of which has been corrupted additively by independent gaussian noise. Probability-of-error expressions are given for the M-ary receiver, which are generalizations of results obtained earlier. From these expressions the optimum time duration for pulse transmissions is computed for two channels—the orbital dipole channel and the moon. Author

N64-17505 Texas Instruments, Inc., Dallas
RADAR ANALYSIS OF THE MOON. PHASE II: SURFACE PROPERTIES Final Report
James D. Shaw and Carl A. Barlow, Jr. 16 Jan. 1964 113 p refs
(Contract AF 19(628)-2478)
(AFCRL-64-74; AD-432403)

Careful evaluation of the relevant diffraction theory for describing radar return from an arbitrary terrain clearly shows the inherent ambiguity between geometrical and electromagnetic contributions and the deficiencies of the frequently used Huygens–Kirchoff theorem. A method for factorizing the geometrical and electromagnetic contributions is demonstrated, under the proviso that a separation between surface texture and gross terrain configuration is permissible. A study was made to determine the extent to which the electromagnetic properties of terrestrial materials (having possible lunar surface counterparts) are influenced by physical state (e.g., crystalline structure, density, grain size, and shape), mineral and chemical composition, and testing conditions (e.g., temperature, pressure, and radar frequency). Analyses were made of data obtained from the literature and X-band (3 cm) experiments on several geologic samples, whose mineralogic and chemical composition had been determined. This work demonstrates the limited value of measurements made of materials in a terrestrial environment and the need for a careful study of postulated lunar materials under simulated lunar environmental conditions. Author

N64-17538 Consiglio Nazionale delle Ricerche, Rome (Italy)
PHILOSOPHY OF COMMUNICATION [FILOSOFIA DELLA COMUNICAZIONE]
Giovanni Polvani Genoa, 1st. Intern. delle Comunicazioni [1963] 11 p Presented to the Comitato Sci. dell' Inst. Intern. delle Comunicazioni, Genoa, 16 Jun. 1963 In ITALIAN

This paper contains the introductory speech made at the meeting of the International Institute of Comunications, which was held in Genoa, Italy, on June 16, 1963. P.F.E.

N64-17621 Library of Congress, Washington, D.C. Aerospace Information Div.
THE SPACE-FREQUENCY SPECTRUM OF HIGH-RESOLUTION RADIO INTERFEROMETERS
23 Mar. 1964 19 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofizika (Gor'kiy), v. 6, no. 3, 1963 p 437–448
(AID-T-64-14; AD-433609) OTS: $1.60 ph, $0.80 mf

The spectra of the space frequencies of high-resolution radio interferometers must be known in order to process the results of radio astronomy observations of the distribution of radio brightness across the sky. The two-dimensional nature of the radiation pattern is taken into account. The possibility of producing an optimum radio interferometer radiation pattern, which would make it possible to obtain the real distribution of radio brightness across the sky with a definite degree of accuracy without further processing, is examined. Author

N64-17644 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
A COMPARATIVE STUDY OF LOW-ANGLE TRACKING SYSTEM PERFORMANCE
R. E. Franks and V. C. Sundberg 25 Nov. 1963 34 p refs
(Contract DA-36-039-AMC-00088(E))
(EDL-M541; AD-432775)

A theoretical study that compares conical-scan, amplitude-monopulse, and phase-monopulse tracking systems is presented. The study examines each tracking system's performance in the absence of reflections, and when reflections are present. A program for computing tracking errors is discussed. Author

N64-17663 Lincoln Lab., Mass. Inst. of Tech., Lexington
ASYMPTOTIC BEHAVIOR OF THE SPECTRA OF RF PULSES WITH LINEAR FREQUENCY MODULATION
S. L. Borison and D. F. De Long 9 Oct. 1963 29 p refs
(Contract AF 19(628)-500; ARPA Order 498; Proj. Defender)
(Rept. 41G-5; AD-421872)

The asymptotic specta of wideband radiofrequency pulses with linear frequency modulation are evaluated. It is specifically shown that at frequencies (measured from the carrier frequency) much larger than the maximum FM deviation the effect of the FM is small. In particular, at a frequency 50 mc higher than the carrier frequency, the envelope of the spectrum of a 10 μsec rectangular pulse with 10-mc FM deviation is less than 1% above the envelope of the spectrum of a pulse with no FM. The spectrum of a cosine pulse with these same characteristics is increased by less than 3%. Author

N64-17692* Hughes Aircraft Co., Culver City, Calif.
STUDY ON OPTICAL COMMUNICATIONS FROM DEEP SPACE Interim Progress Report, 7 Nov. 1962–7 Jan. 1963
Kenneth L. Brinkman 1963 97 p refs
(NASA Contract NAS9-879)
(NASA CR-55815; DCOCS-1) OTS: $8.60 ph, $3.11 mf

The following are discussed: (1) a comparison between microwave and optical communication systems—the electromagnetic propagation range equation, optical transmission

considerations, antenna system gain, transmitted power, transmitter power, transmitter package weight, communication and information theory considerations, system noise, insertion of salient parameters, limitation of tradeoff study, and discussion of tradeoff results; (2) operations systems analysis—communication system requirements, space system requirements, and communication and channel characteristics; (3) optical maser technology—solid-state optical maser, pulse operation, giant pulse, continuous operation, spectral characteristics, gaseous optical masers, and other maser materials; (4) optical detector technology—the theory of transmission by optical means; and (5) modulation and demodulation techniques—carrier modulation, carrier demodulation, general data modulation, laser source coding, and data storage limitations on burst communication techniques. R.T.K.

N64-17773* National Aeronautics and Space Administration. Ames Research Center, Moffet Field, Calif.
MIDCOURSE GUIDANCE USING RADAR TRACKING AND ON-BOARD OBSERVATION DATA
Gerald L. Smith and Eleanor V. Harper Washington, NASA, Apr. 1964 28 p refs
(NASA TN D-2238) OTS: $0.75

The Wiener–Kalman optimal filtering technique is applied to the problem of utilizing combined radar tracking (range and range rate) data and on-board observations for estimating the trajectory of a space vehicle and for guiding the vehicle in cislunar space. Uncertainties included in the problem are bias and nonwhite noise in the radar measurements, radar station location errors, station clock errors, and the error in the knowledge of the velocity of light. The optimal use of the data then provides estimates of the position and velocity state variables and also of the uncertainties. Results obtained show that, in general, radar data are superior to on-board observations for estimating the trajectory. However, the increased accuracy does not greatly enhance overall guidance performance compared to that attainable with only on-board observations. Author

N64-17825 Texas Instruments Inc., Dallas Apparatus Div.
MODIFICATION OF ASR-4 RADAR INDICATOR TO PROVIDE BRIGHT DISPLAY OF RADAR, BEACON, ALPHA-NUMERIC AND SYMBOLIC DATA [4th Quarterly Report]
T. P. Kennedy 1 Feb. 1964 67 p
(Contract FA-WA-4178)
(SP2-A64)

The bright display, readout trigger, and asynchronous beacon portions of the modification are being fabricated. Some sections are now being tested. The design approach for the alphanumeric display portion of the modification has been approved, and fabrication has been started. Author

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-16968 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
FORESHORTENED LOG PERIODIC DIPOLE ARRAY
Claes T. Elfving and Herbert Rosenthal 12 Sep. 1963 26 p refs
(Contract DA-36-039-AMC-00088(E))
(EDL-M401; AD-431250)

This paper describes the development of a constant-width log periodic dipole array with inductively loaded radiating elements. A varying amount of inductive reactance is introduced to the equal-length elements, resulting in elements of varying electrical lengths for broadband operation. While maintaining a constant element-spacing-to-electrical-length ratio and compensating for the increasing Q of the loaded elements by increasing the design ratio τ, good experimental results have been obtained from antenna models with element foreshortenings up to two-to-one. An expression for the varying design ratio τ is developed, the approximate amount of inductive reactance necessary for a given amount of element foreshortening is shown, and performance data of an experimental model are given. Author

N64-16988 Radio Corp. of America, Harrison, N.J.
A 10-Mw, X-BAND TUNNEL-DIODE OSCILLATOR Quarterly Progress Report No. 1, 1 Jul.–30 Sep. 1963
E. Diamond, E. Casterline, R. Gold, and D. Nelson 1963 30 p
(Contract DA 36-039 AMC-03195(E))
(Rept. 03195Q1; AD-431542)

Several gallium–arsenide diodes having peak currents of 50 ma and cutoff frequencies of 15 to 17 Gc were tested in a low-inductance strip-line circuit. At frequencies between 6,100 and 6,700 mc/sec, RF output powers of 0.9 mw were measured. Diodes are presently being fabricated with objective cutoff frequencies of 20 Gc and higher, in order to raise the power level. A waveguide tunable oscillator circuit has been designed and constructed. Author

N64-17120 Washington U., Seattle
PERIODIC STRUCTURES ON CURVED SURFACES
Eric Gung-Hwa Lean and Akira Ishimaru Oct. 1963 32 p refs
(Contract AF 19(628)-2763)
(Tech. Rept. 84; AD-429755)

The present report extends the theory developed for plane periodic structures to cylindrical structures having an azimuthal periodicity. The main object is to obtain k–v diagrams (where v is the complex azimuthal propagation constant). Since the cylindrical structures considered have azimuthal periodicity, the fields can be expanded in accordance with Floquet's theorem in space harmonics. Two particular structures are considered: (1) the curved corrugated surface; and (2) the curved periodic slotted conductors. For (1), the characteristic equation for v is obtained by equating appropriate energies on the surface of the structure; for (2), the characteristic equation is obtained by using the transverse resonance condition. An approximate solution for v is found for structure (1). In this case, a perturbation technique permits obtaining the real and imaginary part of the azimuthal propagation constant for the slow region and for the $n = -1$ leaky wave region. Author

N64-17126 Philco Corp., Blue Bell, Pa. Philco Scientific Lab.
ADVANCED ANTENNA TECHNIQUES Scientific Report No. 1, 1 Dec. 1962–30 Sep. 1963

Leo W. Procopio, Thomas K. Kashihara, Stephen Czorpita, Kenneth Abend, and Terrence A. Lenahan Bedford, Mass., AFCRL, Oct. 1963 200 p refs
(Contract AF 19(628)-2403)
(AFCRL-63-539; AD-432081)

A generalized theory of resolution for linear array antennas is presented. The theory indicates that angular resolution is determined by the width of the autocorrelation of the field pattern and not by the width of the pattern itself. Hence, a well-defined main beam is not a prerequisite for achieving angular resolution; even noiselike beams can be characterized by an autocorrelation function of narrow width. It is shown that this basic principle leads to the concept of angular dispersion and compression, a phenomenon for angular beam patterns akin to dispersion and compression of radar pulses. A new procedure for synthesizing antennas for given resolution properties is also presented. The theory is applied to antennas with time-invariant and time-varying illumination functions, and is used to reexamine classical theories of superdirectivity. Antennas that intimately link resolution properties in range and angle are also analyzed; arrays in which each radiator operates at a different frequency are shown to be examples of this class. Author

N64-17201 Electronics Communications, Inc., Timonium, Md.
MILLIMETER WAVES
Donald D. King *In* Md. U. Proc. of the Space Communications Inst., Md. U., College Park, Jun. 23–28, 1963 1963 p 78–92 refs (See N64-17194 09-08) OTS: $9.10 ph, $3.50 mf

The usefulness of millimeter waves for communications and tracking, from an engineering point of view, depends on three distinct factors: (1) dimensions of the wavelength; (2) quantum noise; and (3) atmospheric propagation. There are three general classes of millimeter-wave generators: (1) conventional electron tubes, such as klystrons, magnetrons, and backward-wave oscillators; (2) harmonic generators and related devices; and (3) megavolt electron-beam schemes. Of these, conventional tubes are the most important from a practical point of view. Three devices used in millimeter wave detection are superheterodyne and direct detection receivers, and masers. For narrow-band service, masers and superheterodyne receivers are most sensitive. For radiometers, the wide acceptance bands of direct-detection receivers may provide equal or better sensitivity, especially at the shortest wavelengths. To achieve low loss at millimeter wavelengths, the energy in waveguides must be spread over a larger cross section. The principal methods for accomplishing this spreading are: (1) overmoded hollow metal guides; (2) trough guides; (3) surface waveguides; and (4) beam guides. I.v.L.

N64-17203* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
POST-AMPLIFIER NOISE TEMPERATURE CONTRIBUTION IN A LOW-NOISE RECEIVING SYSTEM
C. T. Stelzried Repr. from Proc. Inst. Elec. Electron. Engr., v. 52, no. 1, Jan. 1964 2 p refs
(NASA Contract NAS7-100)
(NASA CR-53203; JPL-TR-42-446)

Derivation of expressions describing the equivalent noise temperature of an amplifier terminated in a nonstandard temperature, in terms of a noise-figure meter reading. The result is applied to the measurement of the postamplifier noise temperature contribution in a low-noise receiving system. A typical diagram is included of postamplifier temperature referred to maser output in terms of automatic noise-figure reading with 10-db directional coupler corrected for nonambient source termination. IAA

N64-17250 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
A NEW METHOD OF RECORDING A RAPIDLY VARYING DIELECTRIC LOSS FACTOR [NEUES VERFAHREN ZUR AUFZEICHNUNG EINES SCHNELL VERANDERLICHEN DIELEKTRISCHEN VERLUSTFAKTORS]
H. Moller London, Min. of Aviation, Jan. 1964 19 p refs Transl. into ENGLISH from Elektrotech. Z. (W. Berlin), v. 84, no. 1, 1963 p 8–13
(RAE-Trans-1056)

A new apparatus for recording rapidly varying dielectric loss factors is described, which records a measurement for each period of the measuring a.c. voltage and stores up each measurement until the next one without averaging. The sinusoidal input voltages are converted in a differential amplifier into rectangular wave voltages, and the distances between successive points where the voltage passes through zero values in the same direction are measured. By this method the dielectric loss factors are measured at such a rate that thermal effects are eliminated. Author

N64-17251 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
MOBILITY IN POLYHALOGENOSTYRENE. PART I: INVESTIGATION OF THE FORMS OF MOTION IN POLY-2-FLUORO-5-METHYLSTYRENE BY MEASUREMENT OF DIELECTRIC CONSTANT AND DIELECTRIC LOSS [K VOPROSU O PODVIZHNOSTI MAKROMOLEKUL POLIGALOGENSTIROLOV. I-ISSLEDOVANIE FORM MOLEKULYARNOGO DVIZHENIA POLI-2-FTOR-5-METILSTIROLA METODOM DIELEKTRICHESKIKH POTER' I POLYARIZATSII]
G. P. Mikhailov and T. I. Borisova London, Min. of Aviation, Jan. 1964 13 p refs Transl. into ENGLISH from Vysokomol. Soedineniya (USSR), v. 4, 1962 p 1732–1738
(RAE-Trans-1057)

Molecular relaxation in poly-2-fluoro-5-methylstyrene has been investigated by measurement of dielectric loss and constant in the frequency range 15 cps to 150,000 cps at temperatures from −160° C to +160° C. The substituted phenyl radicals have been found to retain a certain amount of mobility in poly-2-fluoro-5-methylstyrene in the glassy state. At higher temperatures the segmental motion of the main chain and the motion of the side groups merge into a single process, which is described by its own set of relaxation times and its own activation energies. The effective dipole moment of the mobile unit participating in the high-temperature molecular relaxation process has been calculated. Author

N64-17269 Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Lab.
BROADBAND ELECTROMAGNETIC TESTING METHODS. PART III: PARAMETER EXTRACTION
H. L. Libby and K. W. Atwood Nov. 1963 59 p refs
(Contract AT(45-1)-1350)
(HW-79553)

A multiparameter electromagnetic or eddy current test method and prototype tester have been developed that permit the extraction and separation of multiple parameters or variables of a test specimen. A review of applicable signal analysis theory is presented, and principles of the multiparameter eddy current test are given. Four-parameter laboratory test equipment used to demonstrate the principles of operation of the method is described. Test results from this equipment are given in which small variations of three parameters in a simulated test specimen were successfully identified and extracted. As the number of parameters in the test is increased, increasing demand is placed upon instrument stability and accuracy.

The practical limit of the number of parameters that may be extracted depends on the nature of the signals resulting from different parameters. Parameter extraction limitations are greatest for parameters producing nearly similar signals.
Author

N64-17306 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
THIN FILMS FORMED BY ELECTROCHEMICAL REACTIONS Report No. 1 (First Quarterly Progress Report) 31 May-31 Aug. 1963
R. Scot Clark and Jim Dillard [1963] 40 p refs
(Contract DA-36-039-AMC-02324(E))
(AD-425358)

Satisfactory sputtering conditions have been established for tantalum oxide with sheet resistances in the range of several hundred to several thousand ohms per square. This is accomplished by controlling the oxygen partial pressure in the 10^{-5} torr range during sputtering. The measured sheet resistances indicate that more control needs to be exercised on incoming gas conditions. Ultrathin films of molybdenum and tantalum have been successfully deposited on high-temperature substrates for resistors and exhibit excellent stability of 125° C storage. The sheet resistance can be altered over an order of magnitude, and the TCR remains less than 200 ppm/° C.
Author

N64-17315 Tuskegee Inst., Ala. Carver Research Foundation
AN INVESTIGATION OF THE FLOWING MERCURY ELECTRODE Final Report
Lawrence F. Koons 1 Feb. 1964 10 p
(AROD-26912; AD-431811)

Studies of the current–voltage relationship and of the effect of concentration of electrolyzable substances and of mercury flow rate on the limiting current have been made on an analog of the polarographic cell in which the dropping mercury electrode is replaced by an electrode that consists of mercury flowing through a channel in a Teflon block. The limiting current is directly proportional to the concentration of the reducible species and to the mercury flow rate. The precision of the results is poor, apparently as a result of irregular variations in the behavior of the electrode surface. Studies of the results obtained for various empirical modifications of the channel configuration indicate that it will be possible to improve the extent of reproducibility of the results.
Author

N64-17321 Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
THE DOUBLE-HELIX ANTENNA AND ITS VARIANTS: A NEW CLASS OF TUNABLE ENDFIRE ANTENNAS
H. W. Ehrenspeck Dec. 1963 20 p refs
(AFCRL-63-588; AD-432047)

The antennas described in this paper inaugurate a new class of antennas that are tunable for maximum gain in the endfire direction over a wide frequency range; tuning is accomplished by changing the phase velocity continuously or in prescribed steps. Such antennas include certain spatial configurations of the double helix (a novel type of endfire antenna) and its artificial and natural dielectric variants. Useful structures are obtained through parallel displacement of two juxtaposed elements or angular displacement of a scissors arrangement. Model measurements show that maximum gain can be obtained over a frequency range of more than 2:1. Tuning effects are illustrated in detail by means of nearfield plots of a tuned dielectric antenna.
Author

N64-17324 Army Missile Command, Huntsville, Ala. Electromagnetics Lab.
A MICROWAVE CERAMIC TRIODE AMPLIFIER
J. R. Kay 25 Sep. 1963 34 p refs
(RE-TR-63-32; AD-431828) OTS: $3.60

This report describes the development and design of a broadband, low-noise microwave amplifier using ceramic triodes. After the feasibility of ceramic triodes in microwave amplifiers was proven by initial experiments with single-stage and two-stage amplifiers, a four-stage broadband amplifier with an approximately 33-db gain was designed. Experiments were made using the General Electric Z-2869 and 7768 ceramic triodes; the Z-2869 gave better results and was used in the final four-stage amplifier. Bandwidth was measured at the 1-db points. Noise figure was 11.5 db or better across the band, and maximum gain variation across the band was 0.7 db.
Author

N64-17328 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES. TRANSISTOR RELIABILITY Quarterly Progress Report No. 5, May 1, 1963–Jul. 31, 1963
Wayne V. Murdock et al [1963] 12 p
(Contract DA-36-039-SC-86730)
(AD-432466) OTS: $1.60

Progress is discussed in establishing engineering measures that are necessary for attainment of a maximum operating failure of 0.01% per 1,000 hours, at a 90% confidence level, on germanium epitaxial mesa transistor.
P.V.E.

N64-17439 Bendix Corp., Holmdel, N.J. Semiconductor Div.
PRODUCTION RELIABILITY IMPROVEMENT PROGRAM FOR GERMANIUM TRANSISTOR 2N1430. PRODUCTION ENGINEERING MEASURE, VOLUME I Final Report, 30 Apr. 1962-31 Oct. 1963
John Nussear, Henry Sivik, and John Szafranski 1963 124 p
(Contract DA-36-039-SC-86723)
(AD-432235)

The improved techniques have resulted in a reliable product that satisfies the objective failure rate of 0.05%/1,000 hours with 90% confidence. The estimate of failure rate after incorporation of the various production improvements was less than 0.01%/1,000 hours. All required samples have been delivered, all production equipment modifications completed, and appropriate quality and reliability testing performed to demonstrate the success of the operation.
Author

N64-17474 Illinois U., Urbana Antenna Lab.
ON THE ANTENNA NOISE AND ITS MINIMIZATION
Y. T. Lo Sep. 1963 66 p refs
(Contract AF 33(657)-10474)
(Tech. Rept. 74; AD-431496)

A method of estimating various antenna noises is discussed. In the general case, when noise sources are in the near field of the antenna, the problem becomes exceedingly difficult. For this only a high-frequency approximation is suggested; it is similar to the general scattering theory of perfectly conducting scatterers. For a given antenna and a given noise temperature distribution in space, an optimum aperture distribution, discrete or continuous, can be obtained by maximizing the signal-to-noise ratio with a reasonable value of the antenna Q-factor. The solution to this problem is reduced to that of an eigenvalue of a matrix equation.
Author

N64-17507 Syracuse U. Research Inst., N.Y.
SENSITIVITY AND STABILITY IN ACTIVE NETWORK SYNTHESIS Final Report
Donald Melvin 31 Jan. 1964 50 p refs
(Contract AF 19(628)-1649)
(SURI EE975-6401FR; AFCRL-64-47; AD-432158)

The following are discussed: (1) stability of single, negative impedance converter circuit; (2) stability of Huelsman–Yanagisawa circuit; (3) topological formulation of sensitivity functions; (4) methods of topological analysis; and (5) a tree-listing computer program. R.T.K.

N64-17559* Columbia U., Palisades, N.Y. Lamont Geological Observatory
A LOW-NOISE TRANSISTORIZED SEISMIC AMPLIFIER
Stamatios N. Thanos Repr. from Bull. Seismol. Soc. Am., v. 54, no. 1, Feb. 1964 p 347–368 refs
(NASA Contract NASw-82; JPL Contract 950049; JPL Contract 950157)
(*Its* Contrib. No. 675)

The use of transistors for the amplification of fractional microvolt signals at extremely low frequencies is illustrated in the design of an amplifier developed for use in a lunar seismograph. The amplifier has an equivalent input noise voltage of 0.2 microvolts, p-p, with a source impedance of 2,000 ohms and a 3-db bandwidth of 0.035 cps to 22 cps. The nominal input impedance is 1,700 ohms. It is completely transistorized and performs satisfactorily over a specified temperature range of −20° to +100° C. Low power requirements, high reliability, and capability for remote calibration and gain change make this amplifier especially suitable for any field or remote operation under extreme environmental conditions. This amplifier is presently being used in ocean bottom seismographs and magnetic variometers. Author

N64-17630 Daystrom, Inc., Newark, N.J. Weston Instruments and Electronics
A POROUS SUBSTRATE RESISTOR AIMED AT MINIATURIZATION OF METAL-FILM RESISTORS Sixth Interim Development Report [1 Dec. 1963-1 Mar. 1964]
T. Matley and R. E. Busch [1964] 22 p
(Contract NObsr-87542)
(AD-433270)

In order to increase the wattage limits, ceramics with higher thermal conductivity than quartz were investigated. Specifically, alumina was reconsidered for substrate use because of thermal conductivity, availability, and cost. Defects in the substrate structure (fused areas, vacancies, and non-intercommunication of pores) were analyzed with respect to the parameters of weight-to-volume ratio and flow. The results have shown no significant improvement in structure was achieved, as yet. Author

N64-17647 Cutler-Hammer, Inc., Deer Park, N.Y.
SOLID-STATE CIRCUITS Final Report
S. Hamilton, W. W. Heinz, S. Okwit, E. W. Sard, and K. Siegel Oct. 1963 129 p refs
(Contract AF 30(602)-2699)
(Rept. 1654-1; RADC-TDR-63-521; AD-429724)

Two practical varactor limiters were developed—a broadband configuration (octave range) using a pn diode, and a low threshold ultradynamic range configuration. The broadband limiter had a burnout energy in excess of 87,000 ergs, provided 30 db of protection, had a recovery time of 0.5 μsec, and did not exhibit any spike leakage. The low-threshold limiter had a limiting level of less than −20 dbm, an insertion loss of less than 2 db, and a dynamic range of about 70 db. A comprehensive theoretical and experimental technique was developed that was applied to the design and development of octave-wide Y-junction ferrite circulators. These circulators had isolations of greater than 20 db, SWR's of less than 1.4, and insertion losses of about 0.5 db over the complete octave range. A design theory was developed that facilitates the design of low-noise parametric amplifiers having a specified phase or amplitude response. Author

N64-17730 General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
A NEW NON-THERMIONIC ELECTRON GUN
K. L. Boring and L. H. Stauffer [1963] 12 p refs Paper presented at the Natl. Electron. Conf., 28 Oct. 1963

Recent advances in the design of electron guns utilizing cold hollow cathodes are described. Controlled electron beams having energies up to 100 kv have been generated in argon at pressures from 2μ to 10μ. Beam intensities of 2 amp have been obtained with energies up to 20 kv. By means of an auxiliary electromagnetic focusing lens, focal spot sizes approximately 0.01 in. in diameter have been formed for welding experiments. Continuous control of beam intensity, at any desired cathode potential, is accomplished by varying the potential of an internal electrode. Volt-ampere characteristics of the electron beam are given as a function of control electrode potential. Author

N64-17733* National Aeronautics and Space Administration, Washington, D.C.
DETERMINATION OF DYNAMIC PROCESSES IN PIECEWISE LINEAR AUTOMATIC CONTROL SYSTEMS [OPREDELENIYE DINAMICHESKIKH PROTSESSOV V KUSOCHNO-LINEYNYKH SISTEMAKH AVTOMATICHESKOGO REGULIROVANIYA]
K. K. Belya Mar. 1964 23 p refs Transl. into ENGLISH by Electro-Optical Systems, Inc. from Izv. Akad. Nauk SSSR, Otd. Techn. Nauk. Energ. i Avtom. (Moscow), no. 3, 1962 p 163–172
(NASA TT F-132) OTS: $0.75

This paper demonstrates a method of solving certain dynamic problems of nonlinear systems of automatic control with certain piecewise-linear characteristics: for example, the determination of transitional processes of established periodical motions and the investigation of their stability. Author

N64-17752* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ROLLING ELEMENT SLIP RINGS FOR VACUUM APPLICATION
Edward J. Devine Washington, NASA, Apr. 1964 17 p refs
(NASA TN D-2261) OTS: $0.50

Electrical slip rings employing rolling contact elements (balls and raceways) were tested in a hard vacuum environment. Low-noise operation was achieved at speeds up to 5,000 rpm. Slip rings lubricated with MoS_2 operated with lower noise and had a longer life than slip rings employing solid metal film lubrication. Noise generated by rolling slip rings is more severe in air than in a hard vacuum. A technique was developed that operated satisfactorily in air for a time sufficient for preflight testing. A method of replenishing MoS_2 lubrication on the slip rings was devised. The final configuration operated in a vacuum of 2×10^{-9} torr at 2,000 rpm for over 100 million revolutions at a noise level of 0.002 ohm rms. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-16947 Training Center for Experimental Aerodynamics, Rhode-Saint-Genese (Belgium) Von Karman Inst. for Fluid Dynamics

THE V. K. I. F. D. HIGH SPEED AXIAL COMPRESSOR TEST FACILITY R-2

J. Chauvin, F. Breugelmans, and M. Thiry Jan. 1964 36 p refs (VKI-TM-17)

This facility is designed to obtain fundamental information on axial flow compressors in the subsonic, transonic, and supersonic range of relative inlet velocities. The tests in the supersonic range are possible only when using Freon or a similar gas as test medium. Provision is made for the testing of single rotors and of complete stages (inlet guide vanes, rotor, stator). Author

N64-16954 Cold Regions Research and Engineering Lab., Hanover, N.H.

CAMP CENTURY MOVEMENT RECORD Technical Report 121 [Oct. 1960–May 1962]

Robert W. Waterhouse, Wayne N. Tobiasson, and Barrat G. Scott May 1963 84 p refs (AD-430148)

Snow deformation studies are being made in the undersnow facilities at Camp Century on the N. Greenland Ice Cap to define the "useful life" of such facilities. The initial measurements were made in Aug. 1959 and since then cross-section measurement stations, settlement recording Helipots (helical potentiometers), and a camp bench mark system have been installed. Results through May 1962 are presented. Twenty-nine Helipots, installed on structures within the tunnels, record movement between the structure and the tunnel arch or floor. The various Helipot installations are diagramed, and the relative movements recorded by each are graphed. The 19 tunnel cross sections being studied are also diagramed, and rates of closure at each station are graphed; the elevation variations of the bench marks with time are tabulated. Author

N64-17018* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

PLANETARY ENTRY SIMULATION BY MEANS OF COMBUSTION

Richard D Wood and R. Liaugmines (Ill. U.) *In* Am. Inst. of Aeron. and Astronautics AIAA Aerodyn. Testing Conf. [1964] p 135–160 refs (See N64-17013 09-01) AIAA: $5.00 members, $10.00 nonmembers

(NASA Contract NAS7-100)

The problem of the penetration and landing of an instrumentated capsule on Mars and Venus is discussed. The problem of planetary entry is examined in light of present day knowledge of the atmospheres of Mars and Venus. Using typical entry trajectories and expected flight conditions, aerodynamic regimes can be considered and the flow parameter requirements for ground simulation can be estimated. The concept of simulation of these conditions by means of a combustion-heated hypervelocity wind tunnel is considered, and the region of applicability is discussed. R.T.K.

N64-17019* National Aeronautics and Space Administration. Flight Research Center, Edwards, California

AERODYNAMIC TESTING USING SPECIAL AIRCRAFT

Hubert M. Drake *In* Am. Inst. of Aeron. and Astronautics AIAA Aerodyn. Testing Conf. [1964] p 178–188 refs (See N64-17013 09-01) AIAA: $5.00 members, $10.00 nonmembers

Some of the recent applications of special aircraft to aerodynamic testing are reviewed, and the relationship that such testing bears to theory and to research in ground facilities is discussed. R.T.K.

N64-17259 International Civil Aviation Organization, Montreal (Canada)

AIR NAVIGATION PLAN – SOUTH EAST ASIA REGION

Dec. 1963 152 p In ENGLISH, FRENCH, and SPANISH (Doc. 7774/7) Available from ICAO, Intern. Aviation Bldg., 1080 Univ. St., Montreal (Canada): $3.75

This document presents the ICAO plan for the provision of facilities and services for international air navigation in the ICAO southeast Asia region. These facilities and services are: (1) airdromes; (2) air-traffic services; (3) communications; (4) meteorology; (5) search and rescue services; and (6) aeronautical information services. Also, the extent to which the recommended facilities and services have been provided is indicated. I.v.L.

N64-17304 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

AERO SPORT (SELECTED ARTICLES) NO. 1, 1963

4 Apr. 1963 15 p refs Transl. into ENGLISH from Aero-Sport (E. Germany) p 18–19 and 29–31 (FTD-TT-63-213/1; AD-402583)

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N64-17348 Joint Publications Research Service, Washington, D.C.

SHALLOW-DRAFT PLASTIC LAUNCH

V. P. Smirnov and N. A. Sosunov 20 Mar. 1964 5 p Transl. into ENGLISH from Plasticheskie Massy (Moscow), no. 1, 1964 p 71–72 (JPRS-23786; OTS-64-21848) OTS: $0.50

The shallow-draft plastic launch, which has successfully undergone comprehensive tests, is a comfortable, open, pleasure craft of the "R" class that is intended for boating on canals, rivers, and reservoirs. The hull of the launch is made of a plastic, based on the MGF-9 and TMGF-11 polyether cold-hardening resin. The hull is made of two parts, and is assembled on a transverse frame system. The entire frame is cemented to the plating with cement resin; the resin must overlap the plating. Along the bottom, the hull is reinforced with ribs, rigidity members, floors, and air boxes. The hull frame is filled with PS-1 foamed plastic. The stem of the launch consists of 4-mm-thick plating, pine reinforcement 30 mm in cross section, and 5- and 10-mm-thick plywood. The bow is bound with a brass

band. The deck framing consists of beams, below-deck ribs, and knees. The launch is powered by a GAZ-69 engine, and is controlled by means of an automobile-type steering wheel. The total power (225 watts) is provided by storage batteries. I.v.L.

N64-17478 IIT Research Inst., Chicago, Ill. Technology Center

FEASIBILITY STUDY FOR A LARGE BLAST SIMULATOR, VOLUME I Final Report [1 May 1961-30 Jun. 1962]

A. H. Wiedermann, J. J. Swatosh, Jr., and E. Guillard Jan. 1964 270 p refs

(Contract DA-49-146-XZ-064)

(IITRI-6035, Vol. 1, Final; DASA-1321; AD-427807)

The purpose of this study is to determine the most feasible means of obtaining a nuclear blast simulator that will reproduce the transient flow field associated with the 500 psig overpressure range of large nuclear weapons detonation. A large number of potential blast simulator concepts were evaluated, and their performance characteristics were determined. Preliminary designs were made for those concepts that possessed the best overall performance characteristics, and estimates of their cost feasibility were established. Two concepts were considered the most feasible. The first is the standard shock-tube concept, which consists of a long tube, closed at one end, in which explosives are distributed over a large region and detonated. The second is the space variable energy-input shock-tube concept. This latter concept consists of a long tube, open at both ends, in which explosives are distributed in a nonuniform manner. The resulting detonation yields longitudinal pressure gradients that are similar to the waveforms of interest. Both of these concepts simulate the overpressure and dynamic pressure variation in the test section satisfactorily. I.v.L.

N64-17490 Federal Aviation Agency, Washington, D.C. Library Services Div.

AIRPORTS AND HELIPORTS: PLANNING, MANAGEMENT AND OPERATIONS, SAFETY. SELECTED REFERENCES

Dec. 1963 96 p refs

(*Its* Bibliog. List No. 10)

This bibliography is a partially annotated compilation of selected references with international coverage from 1959 through 1963. I.v.L.

N64-17521 ARO, Inc., Arnold Air Force Station, Tenn.

CONDENSATION IN HOTSHOT TUNNELS

B. J. Griffith, H. E. Deskins, and H. R. Little Arnold Eng. Develop. Center, Feb. 1964 28 p refs

(Contract AF 40(600)-1000)

(AEDC-TDR-64-35; AD-431046)

Tests have been conducted to determine the effects of condensation of nitrogen in the AEDC Hotshot Tunnels H and F. Free-stream static pressure was determined by an extrapolation of sharp flat-plate pressure data and an analysis of the nozzle static pressures. It is shown that the amount of supersaturation that can be achieved at high Mach numbers in air can also be obtained using nitrogen as the test gas. Author

N64-17540 Advisory Group for Aeronautical Research and Development, Paris (France)

THE STOPPING OF AIRPLANES AT LANDING [L'ARRET DES AVIONS A L'ATTERRISSAGE]

E. Racca (Centre de Essais en Vol) Jan. 1963 21 p In FRENCH; ENGLISH summary

(AGARD-435)

The problem of stopping airplanes on landing can be dealt with from two different points of view: (1) performance—stopping the airplane over a given distance with its own mechanism; (2) safety—having a safety device on the landing field for stopping the airplane without damage to it or to its occupants should the airplane's own mechanism break down or prove inadequate. This report discusses the second problem, that of stop barriers. Author

N64-17545 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany)

DIRECTION OF EFFORT, RESEARCH FUNCTIONS, AND TEST INSTALLATIONS OF THE INSTITUTES OF THE GERMAN RESEARCH INSTITUTE FOR AERONAUTICS AND SPACE TRAVEL [ARBEITSRICHTUNG, FORSCHUNGSAUFGABEN, UND VERSUCHSANLAGEN DER INSTITUTE DER DEUTSCHEN VERSUCHSANSTALT FUR LUFT- UND RAUMFAHRT E.V.]

A. W. Quick and H. Ebner Sep. 1963 54 p refs In GERMAN Available from Vereinigte Universitäts- u. Fachbuchhandlungen, R.-Wagner-Str. 1, Cologne, W. Germany

This report presents a survey of the present and future research projects of the 20 institutes of the DVL. These are the institutes for: (1) applied gas dynamics; (2) theoretical gas dynamics; (3) turbulence research; (4) applied mathematics and mechanics; (5) jet engines; (6) static- and dynamic-load investigations and the related measuring instruments; (7) materials research; (8) chemical rockets; (9) rocket fuels; (10) aircraft fuels and lubricants; (11) spectroscopy and the molecular-beam technique; (12) space research; (13) plasma dynamics; (14) flight mechanics; (15) free-flight investigations; (16) guidance and control techniques; (17) aircraft radio and microwaves; (18) atmospheric physics; (19) aircraft carrying special measuring instruments; and (20) flight medicine. Also, the construction of three central research installations is discussed. These installations are in Wahn, Oberpfaffenhofen, and Stuttgart. I.v.L.

N64-17596 Sandia Corp., Albuquerque, N. Mex.

SUMMARY OF STAGNATION CHAMBER TEMPERATURE STUDIES IN THE SANDIA 5-INCH HYPERSONIC WIND TUNNEL

Raymond A. Mitchell and Kennith L. Goin Feb. 1964 29 p refs

(SC-4976(RR))

A summary is presented of the total temperature variance with time and position in the stagnation chamber of the 5-in. hypersonic wind tunnel, of the experiments performed in an effort to find the origin of the temperature variance, and of the tests performed to determine the merit of several air mixers for the stagnation chamber. A conical orifice mixer was found to meet the performance requirements of reducing temperature gradients to less than 1 percent and of eliminating the temperature fluctuations. Author

N64-17640 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

IMPROVEMENTS OF AERIAL-BEACON INSTALLATIONS, PARTICULARLY OF THOSE HAVING A BEACON SUPPORTED BY AT LEAST ONE FAIRED AIR SCREW

H. P. G. A. R. von Zborowsky 25 Feb. 1964 30 p Transl. into ENGLISH by JPRS from Belgium Patent 569094 (1961)

(RSIC-141; AD-432298)

A description is presented of an aerial beacon installation, consisting of an aerial part (supported by a faired air screw)

connected with a control part by means of a flexible attachment device whose length may be changed in order to regulate the height of the aerial part. It is suggested that the apparatus could be used to raise and to maintain, at a selected altitude, types of apparatus of installations (e.g., TV cameras, radars, TV relay stations, platforms for surveillance of forest fires, etc.) that require an elevated position. P.V.E.

N64-17646 American Machine and Foundry Co., Stamford, Conn. General Engineering Div.
A STUDY OF AEROSPACE GROUND EQUIPMENT REQUIREMENTS FOR LARGE SOLID PROPELLANT ROCKET MOTORS, VOLUME I Final Report
W. Rosenbaum and R. Abramowitz Edwards AFB, Calif., Rocket Propulsion Lab., Jun. 1963 456 p refs
(Contract AF 04(611)-8187)
(RTD-TDR-63-1025, Vol. 1; AD-410981)

The work performed during the study encompassed the following: (1) an extensive survey of Government agencies and industry firms to compile available information and advanced thinking in areas of equipment, transportation, and handling techniques as applied to large solid-propellant rocket motors; (2) review of existing studies and abstracting of the most promising available documents for use as background material; (3) compilation and evaluation of concepts for handling, transportation, static test, and assembly-to-upper-vehicle stages of the large solid-propellant rocket motors; (4) establishment of detailed handling procedures for solid-propellant rocket-motor components at the manufacturer's site, static test area, and launch site; (5) establishing of budgetary costs for the equipment involved. Author

N64-17788* Naval School of Aviation Medicine, Pensacola, Fla.
INSTRUMENTATION FOR THE PENSACOLA CENTRIFUGE-SLOW ROTATION ROOM I FACILITY
W. Carroll Hixson 17 Oct. 1963 26 p refs
(NASA Order R-37)
(NASA CR-53341; Rept. 88) OTS: $2.60 ph, $0.98 mf

A description is provided of the control and data-acquisition capabilities of a new instrumentation system that has been developed for the implementation of vestibular research studies aboard the Pensacola Centrifuge–Slow Rotation Room I Facility. The system is discussed in terms of the specific equipments made available for both improved operational control of the device and increased data collection, transmission, and storage capabilities with particular emphasis given to the approach used to provide flexibility in the acquisition of data from various on-board experimental areas. Author

N64-17796* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HISTORY OF THE GEORGE C. MARSHALL SPACE FLIGHT CENTER FROM JANUARY 1 THROUGH JUNE 30 1963, VOLUME ONE MSFC Historical Monograph No. 7
Nov. 1963 248 p
(NASA TM X-51523; MHM-7) OTS: $16.00 ph, $7.64 mf

In this report period, Saturn research and development and project management of RIFT (reactor-in-flight-test) were continued. The fourth successful flight in four launches of the giant Saturn rocket was made. During this test flight, the vehicle accomplished all its primary missions and, for the first time in the history of rocketry, demonstrated an engine-out capability. In addition to a list containing the most historically significant events at the space center during the report period, the following are discussed: Saturn I, Saturn IB, Saturn V, and the nuclear rocket program. R.T.K.

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-16910 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 72
10 Mar. 1964 22 p refs Transl. into ENGLISH of 2 articles from K'o Hsueh T'ung Pao (Peking), no. 10, 1963 p 40–44 and 47–49
(JPRS-23592; OTS-64-21750) OTS: $2.00

CONTENTS:

1. THEORETICAL ANALYSIS OF LIQUID PHASE MASS TRANSFER OF WET-WALL TOWER Chiang Kuo Liang and Chu Pao Lin 11 p (See N64-16911 09-11)

2. RESISTANCE OF MASS TRANSFER AT THE INTERFACE OF FLOWING GAS AND LIQUID AND THE MECHANISM OF ITS PRODUCTION Li P'an-sheng, Yen Tzu-Kang, Chao Heng-lang, and Ma Yin-ming 8 p refs (See N64-16912 09-11)

N64-16911 Joint Publications Research Service, Washington, D.C.
THEORETICAL ANALYSIS OF LIQUID PHASE MASS TRANSFER OF WET-WALL TOWER
Chiang Kuo Liang and Chu Pao Lin *In its* Transl. on Communist China's Sci. and Technol. No. 72 10 Mar. 1964 11 p (See N64-16910 09-11) OTS: $2.00

The flow equations in the accelerating region close to the liquid entrance of the wet-wall tower were solved, and the rules of radial and axial velocity distributions and of change in the thickness of liquid film were obtained. The results are similar to the experimental data. The momentum and mass-transfer equations were combined and the d.c. current method was used to calculate, theoretically, the mass-transfer coefficient of the liquid phase. Comparing the results with experiments, the errors are within 5%. The analysis of the mass-transfer process in the accelerating region close to the liquid entrance shows that the acceleration of the redistribution of the inner liquid is an important way to strengthen the mass-transfer process. Author

N64-16912 Joint Publications Research Service, Washington, D.C.
RESISTANCE OF MASS TRANSFER AT THE INTERFACE OF FLOWING GAS AND LIQUID AND THE MECHANISM OF ITS PRODUCTION
Li P'an-sheng, Yen Tzu-kang, Chao Heng-lang, and Ma Yin-ming *In its* Transl. on Communist China's Sci. and Technol. No. 72 10 Mar. 1964 8 p refs (See N64-16910 09-11) OTS: $2.00

The effect of both the interfacial resistance of the injection flow and the surface activator on the rate of absorption and the mechanism of the resistance produced by both factors was investigated. A laminar injection-flow absorber was used. The system investigated was CO_2–H_2O. The activators were La-k'ae powder B_x and sodium hexadecyl sulfonate. The diffusivity of the CO_2 into H_2O was assumed to be

1.97×10^{-9} m^2/sec. Results in graphic form are presented of: (1) the relationship between the contact time and the rate of absorption of CO_2 by pure H_2O; (2) the effect of the concentration of the surface activator on the rate of absorption of CO_2; and (3) the effect of contact time on the decrease of the absorption rate under constant concentration of the surface activator. Graph (3) represents the results of an investigation of three cases: when $t \leq t_n$, where t is the exposure time and t_n is the time required to reach saturation; $t > t_n$; and $t >> t_n$. I.v.L.

N64-16915* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ANALYSIS OF MIXING OF COAXIAL STREAMS OF DISSIMILAR FLUIDS INCLUDING ENERGY-GENERATION TERMS

Herbert Weinstein and Carroll A. Todd Washington, NASA, Mar. 1964 59 p refs

(NASA TN D-2123) OTS: $1.50

A solution to the problem of the mixing of coaxial flows of dissimilar fluids is presented. The solution is numerical in nature and permits large variations of density, velocity, and temperature of the fluids. It is valid close to or away from the flow inlet. The system considered is that of a heavy inner fluid surrounded by a light outer stream that is infinite in extent. The fluids may have any initial temperature and velocity profiles, and the flow may be laminar or turbulent in nature. Provision is made for energy generation throughout the flow field. Results are calculated for various cases to compare the analysis with two sets of experimental data, to illustrate the effect of an approximation of the case with a boundary on the outer stream, and to show the effect of initial input value on the bulk acceleration of the inner-stream fluid. Author

N64-16982 General Electric Co., Philadelphia, Pa. Space Sciences Lab.

THE INVISCID REACTING FLOW FIELD ABOUT HYPERSONIC BODIES

V. A. Langelo Dec. 1963 38 p refs

(Contract AF 04(694)-222)

(R63SD90; AD-431919)

A simple method for the determination of the flow field about any axially symmetric body shape for any conditions of hypersonic flow is described. The method involves the combination of stream tubes in the field and obtains a solution of the complete field by an iteration process that starts with initial guesses for the body pressure distribution and the shock shape and location. This technique has been successfully applied to the solution of the flow field about axially symmetric bodies with ideal or equilibrium gases, including bodies with slope discontinuities where no secondary shocks exist in flow. The complete flow field solution is obtained, given only the body shape and size and the free-stream conditions. Author

N64-16989 Pennsylvania State U., University, Park

FURTHER STUDIES OF CURVED MIXING FLOWS Interim Technical Report

David P. Margolis 29 Jan. 1964 7 p

(Contract DA-31-124-ARO(D)-153)

(AROD-4491-1; AD-431815)

The values of $R\lambda$ (the turbulence Reynold's number) calculated for the stable and unstable curved mixing layers are plotted. Values of $R\lambda$ as high as 1,650 exist in the unstable curved mixing layer. Ordinarily, a large value of the turbulent intensity and a large λ are incompatible, since the larger the value of λ the smaller the wave number at which viscous forces be important. However, in the unstable curved mixing layer, the turbulent transport level is large enough so that it is possible to have a high turbulence level and a large λ simultaneously. Also, the one-dimensional energy spectra in the stable and unstable layers were plotted in Kolmogoroff coordinates. In the stable case, a range of $K^{-5/3}$, not quite one decade long, is obtained, whereas in the unstable case a range of $K^{-5/3}$, almost two decades long, is obtained. If a straight line, which best fits the data, is drawn through the $-5/3$ portion of the curves and the value of the ordinate is noted where this line intercepts the line $\eta K = 1$, then the value of the constant α, in the Kolmogoroff form, in the spectrum may be determined. I.v.L.

N64-17160* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

IDEAL-GAS TABLES FOR OBLIQUE-SHOCK FLOW PARAMETERS IN AIR AT MACH NUMBERS FROM 1.05 TO 12.0

John S. Dennard and Patricia B. Spencer Washington, NASA, Mar. 1964 158 p refs

(NASA TN D-2221) OTS: $3.00

Oblique-shock tables are presented for air with initial Mach numbers from 1.05 to 12.0 and flow-deflection angles from 0° up to the maximum turning angle for attached flow. Parameters presented are flow-deflection angle, shock-wave angle, total-pressure ratio, static-pressure, density, and temperature ratios, downstream Mach number, ratio of downstream velocity to maximum velocity, and increase in entropy. Perfect-gas equations have been used throughout these calculations. Author

N64-17185 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

DETERMINING THE BASE PRESSURE AND BASE TEMPERATURE OF THE SUDDEN EXPANSION OF A SONIC OR SUPERSONIC FLOW

R. K. Tagirov *In its* News of the Acad. of Sci. of the USSR, Dept. of Tech. Sci., Mech. and Machinery Manufacture (Selected Articles) 5 Apr. 1963 p 8–20 refs (See N64-17183 09-01)

A method for determining the effect of base pressure and base temperature on the sudden expansion of a plane or axially symmetrical flow is presented. The method is based on Korst's method, but in contrast to his method, the nonisothermic quality of mixing is taken into account. Korst's method is extended to cases of sudden expansion of an axially symmetrical flow toward the axis of symmetry. A comparison of the results of the computations obtained with the method proposed in this paper with the data of other authors is included. R.T.K.

N64-17186 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

NEWS OF THE ACADEMY OF SCIENCES OF THE USSR (SELECTED ARTICLES) NO. 3, 1961

28 Mar. 1963 40 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSSR. Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow) p 40–57

(FTD-TT-63-222/1+2+4; AD-402581)

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1. AN HYPOTHESIS ON THE UNIVERSALITY OF EJECTION PROPERTIES OF TURBULENT GAS JETS AND ITS APPLICATION O. V. Yakovlevskiy p 1–30 refs (See N64-17187 09-11)

2. MIXING TURBULENT JETS OF DIFFERENT DENSITY G. N. Abramovich p 31–37 refs (See N64-17188 09-11)

N64-17187 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

AN HYPOTHESIS ON THE UNIVERSALITY OF EJECTION PROPERTIES OF TURBULENT GAS JETS AND ITS APPLICATION

O. V. Yakovlevskiy *In its* News of the Acad. of Sci. of the USSR (Selected Articles) No. 3, 1961 28 Mar. 1963 p 1–30 refs (See N64-17186 09-11)

A hypothesis is proposed that is concerned with the universality of the ejection properties of turbulent jets. According to this hypothesis, the intensity of the accumulation of mass by the jet (the jet's ejection capacity) is proportional to its initial momentum. R.T.K.

N64-17188 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

MIXING TURBULENT GAS JETS OF DIFFERENT DENSITY

G. N. Abramovich *In its* News of the Acad. of Sci. of the USSR (Selected Articles) No. 3, 1961 28 Mar. 1963 p 31–37 refs (See N64-17186 09-11)

A method is proposed for taking into account the influence of the compressibility of a medium on the thickness of jet mixing zones. This method agrees with all available experimental data in the cases of a submerged gas jet, of mixing of jets of incompressible fluid, and of mixing of jets of different density but nearly equal velocity heads. R.T.K.

N64-17234 Advisory Group for Aeronautical Research and Development, Paris (France)

MEASUREMENTS OF THE CORRELATION BETWEEN THE FLUCTUATING VELOCITIES AND THE FLUCTUATING WALL PRESSURE IN A THICK TURBULENT BOUNDARY LAYER

W. W. Willmarth and C. E. Wooldridge Apr. 1963 72 p refs Presented at the AGARD Specialists' Meeting on "Mech. of Noise Generation in Turbulent Flow", Rhode-Saint-Genèse, Belgium, 1–5 Apr. 1963 In ENGLISH; FRENCH summary (AGARD-456)

Turbulent motion in a thick (5-inch) boundary layer with zero longitudinal pressure gradient that is produced by natural transition on a smooth surface has been studied. Measurements have been made of the space–time correlation between the fluctuating wall pressure and the fluctuating velocities in the layer, and between the fluctuating wall pressure and the time derivative of the fluctuating velocity normal to the wall. At any height in the boundary layer, the velocity disturbance that was correlated with the wall pressure disturbances was convected at the local mean speed. The approximate structure of the pressure velocity correlation was obtained from measurements of the space–time correlation between the wall pressure and the fluctuating velocity at various points in the layer. Isocorrelation contours with zero time delay were mapped in three orthogonal planes parallel and perpendicular to the wall. Author

N64-17368 General Electric Co., Philadelphia, Pa. Space Sciences Lab.

A THEORY OF HYPERSONIC LAMINAR AND TURBULENT VISCOUS WAKES AT CHEMICAL EQUILIBRIUM

K. S. Wen [1964] 28 p refs (R63SD01)

An analysis of laminar and turbulent viscous wake for a body at hypersonic speeds is presented. The Lewis number is assumed to be one, but the Prandtl number is left arbitrary but constant. The gas is considered in chemical equilibrium. The flow in the base region is treated first, starting with the free expansion at the base of the body and considering the subsequent mixing of the flow from the initial finite boundary layer with the external inviscid flow and the "dead air" confined near the base. The development of the viscous core within the inviscid wake from the base flow into the near and far wake regions is then investigated. The present theory can be applied to both blunt and slender bodies. Preliminary results of the temperature and velocity profiles for a 10° cone at hypersonic conditions are given. Author

N64-17435 General Electric Co., Philadelphia, Pa. Space Sciences Lab.

A MODEL FOR THE TRANSITION REGIME IN HYPERSONIC RAREFIED GAS DYNAMICS

B. B. Hammel Oct. 1963 55 p refs Presented at the AIAA Conf. on Phys. of Entry into Planetary Atmospheres, Mass. Inst. of Tech., 26–28 Aug. 1963 (Contract AF 04(694)-222) (R63SD85; AD-431228)

A new, two-fluid model for the hypervelocity rarefied regime is presented. This work avoids many of the shortcomings of the previous multifluid models and results in a set of partial differential moment equations, which are of the same order of difficulty as the conventional gas dynamic equations. These equations are analyzed for the case of one-dimensional hypersonic compression (piston problem), and numerical results are presented. The velocity and density profiles are shown as functions of time and distance from the plate, and the speed ratio of the cold fluid (scattered and free-stream particles) is plotted. Although the model does not provide a description of the entire transition between free molecule flow and a fully developed shock wave, the results obtained for the piston problem do give insight into the initial phase of shock formation. Author

N64-17455 ARO, Inc., Arnold Air Force Station, Tenn.

INVESTIGATION OF FLOW SEPARATION ON A TWO-DIMENSIONAL FLAT PLATE HAVING A VARIABLE-SPAN TRAILING-EDGE FLAP AT $M_\infty = 3$ AND 5

S. R. Pate Arnold Eng. Develop. Center, Mar. 1964 42 p refs (Contract AF 40(600)-1000) (AEDC-TDR-64-14; AD-432831)

An experimental investigation of separated boundary-layer flow was conducted on a two-dimensional flat plate having a variable-span trailing-edge flap in the 12-in. Supersonic Tunnel (D) of the von Kármán Gas Dynamics Facility. The tests were made at Mach numbers 3 and 5 at zero angle-of-attack and over a Reynolds number range (based on plate length) from 0.26 to 16.7×10^6. Model surface pressure distributions, Schlieren photographs, and velocity distributions are presented. The effects of unit Reynolds number, plate length, flap span, and flap deflection angle on the separated region are investigated, and comparisons are made with existing theory. Author

N64-17471 International Business Machines Corp., San Jose, Calif. Research Lab.

A RECURSIVE APPROACH TO THE THEORY OF SLOW, STEADY-STATE VISCOELASTIC FLOW

W. E. Langlois 30 Oct. 1963 82 p refs (Contract Nonr-3448(00)) (RJ-227; AD-421948)

The slow, steady-state motion of an arbitrary Rivlin–Ericksen fluid is considered. By perturbing about a state of rest, equations governing the first- , second- , and third-order flow fields are developed in such a way that the second-order theory uses explicitly the first-order results, etc. The first-order equations

are those of creeping viscous flow; the second-order theory introduces two parameters associated with the viscoelasticity of the fluid; the third-order theory brings in three more. Fluid inertia is neglected throughout. To facilitate application, the flow equations, derived in Cartesian tensor notation, are rewritten in general tensor notation; the equations are explicitly given both for cylindrical and spherical coordinate systems. Several elementary flow problems of technological importance are solved: flow between parallel plates; the Poiseuille problem; helical flow in an annular region; torsional flow between discs. Author

N64-17472 Rand Development Corp., Cleveland, Ohio
CONTRIBUTIONS TOWARD SOLUTIONS OF THE EQUATIONS OF HYDRODYNAMICS. PART A: THE CONTINUUM LIMITATIONS OF FLUID DYNAMICS
A. S. Iberall Dec. 1963 272 p refs
(Contract Nonr-3405(00))
(AD-430718)

The object of these studies is to develop an analytic methodology for solving hydrodynamic problems for both laminar and turbulent flow. The physical background and limitations of the pertinent hydrodynamic equations are discussed. In particular, continuum fluid mechanics is delimited from bordering fields of rheological flow, of multiphase flow, and of noncontinuum flow because of high frequency or high vacuum. This exploration leads to specific parametric criteria for which the continuum-flow equations are valid. The general method of solution for laminar flow is sketched out for a particular boundary-value problem. The turbulent flow equations for the same boundary-value problem are introduced. Author

N64-17519 Library of Congress, Washington, D.C. Aerospace information Div.
SUPERSONIC AND HYPERSONIC FLOW Annotated Bibliography of Soviet Literature
21 Jan. 1964 93 p 307 refs
(AID-B-64-3; AD-431286) OTS: $8.60 ph, $2.99 mf

This report is divided into three main sections: Aerodynamics, Gasdynamics, and General Flow Phenomena. An attempt is made in the first section to cover dynamic phenomena associated with high-velocity flow of gases over bodies, including rarefied and free-molecular flow. The second section covers the problems associated with internal flow, e.g., flow in nozzles, wind tunnels, and shock tubes. Similarity concepts are also included in this section. The third section deals with general flow phenomena at supersonic and hypersonic velocities. Author

N64-17541 Advisory Group for Aeronautical Research and Development, Paris (France)
MEASURE OF ATMOSPHERIC TURBULENCE AT VERY LOW ALTITUDE AND GREAT SPEED [MESURE DE LA TURBULENCE ATMOSPHERIQUE A TRES BASSE ALTITUDE ET GRANDE VITESSE]
Jean Angelini (France. Min. de l'Air) Apr. 1963 8 p In FRENCH; ENGLISH summary
(AGARD-441)

During the year 1962, the Technical & Industrial Administration of Aeronautics of the French Official Services decided to undertake a project for measuring atmospheric turbulence, the aim being to study the behavior of pilots and aeroplanes during very low altitude missions. This report describes this project. Author

N64-17546 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Freiburg (W. Germany)
INSTITUTE FOR APPLIED MATHEMATICS AND MECHANICS REPORT PERIOD: CALENDAR YEAR 1962 [INSTITUT FUR ANGEWANDTE MATHEMATIK UND MECHANIK BERICHTSZEITRAUM: KALENDERJAHR 1962]
Henry Görtler Sep. 1963 5 p refs Spec. print. from the Activity Rept. of the Res. Inst. of the German Res. Inst. for Aeron. and Space Travel In GERMAN

This report gives an insight into the research, conducted at the institute on: (1) nonstationary boundary layers in a shock tube, with emphasis on aerodynamic heating; (2) the calculation of a weak compression shock in a "flowed-through" tube; (3) the calculation of the Rayleigh boundary layer in a dissociated gas at hypersonic speed; (4) the construction of an approximation for the practical calculation of laminar and turbulent flow and temperature boundary layers; (5) an approximation that permits a numerical solution of linear, nonstationary perturbation equations on the basis of initial perturbations; (6) the stability conditions of flows with thermal convection; (7) stagnation-point instability compared with Taylor–Görtler type perturbations, as well as the influence of surface tension and the temperature dependence of viscosity on the stability of a flowing liquid layer; (8) the development of more rigid mathematical stability criteria, which are not based upon the theory of small perturbations, and which have been applied in the field of magnetohydrodynamics; (9) the demonstration, in a typical flow example, that a branched stationary flow exists as a critical parameter value, which means that near the initial flow a second stationary-flow form appears as a solution to the nonlinear motion equations; (10) the two- and three-dimensional instability phenomena in laminar flow; and (11) the numerical treatment of integral equations. I.v.L.

N64-17571 Nagoya U. (Japan)
COLLISIONLESS EXPANSION OF GASES OF FINITE AMOUNT INTO VACUUM
Shigeo Uchida, Kyoshi Watanabe, and Haruhiko Takada 30 Oct. 1963 16 p refs
(Sponsored by Min. of Educ.)

The expansion of gas molecules into vacuum ejected in a finite period is investigated on the basis of the collisionless Boltzmann equation. It is shown that the cloud of molecules diffuses into space, advancing with mass velocity, and that the distribution of density is fairly deformed by individual mass velocity. Author

N64-17605* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HEAT AND MASS TRANSFER IN BINARY INERT GAS FLOW FOR DISTRIBUTIONS OF TEMPERATURE AND CONCENTRATION RENDERING THE PROPERTIES NEARLY CONSTANT
Ernst W. Adams, John D. Warmbrod, C. Lee Fox, and Robert M. Huffaker 15 Jan. 1964 50 p refs
(NASA TM X-54519; MTP-AERO-64-2) OTS: $4.60 ph, $1.70 mf

Injection of a foreign gas into the laminar air boundary layer is considered. The mixture properties are arbitrary functions of temperature T and foreign gas concentration w. Unless the properties are constant, similarity transformations are valid only at the stagnation point or for a wall at constant pressure. A correlation formula of rigorous numerical solutions for q_w/q_{w0} has been derived for the constant pressure case. Here, q_w is the heat transfer in the presence of mass transfer, whose absence is denoted by subscript 0. This correlation formula is linear in the mass transfer rate $\rho_w v_w$, and, therefore, fails

for large values of $\rho_w v_w$. A simple engineering solution method of the similarity equations is proposed, which gives those points of the q_w/q_{w0} versus $\rho_w v_w$ relationship for which five property parameters are nearly constant across the boundary layer. If these five conditions are satisfied, the differential equations in similarity variables can be uncoupled. Correlation formulas for q_w are presented for both the constant pressure and the stagnation point cases. Author

N64-17674* Southwest Research Inst., San Antonio, Tex.
MEASUREMENTS OF LIQUID NATURAL FREQUENCIES AND DAMPING IN COMPARTMENTED CYLINDRICAL TANKS Technical Report No. 8
Luis R. Garza 5 Feb. 1964 27 p refs
(NASA Contract NAS8-1555)
(NASA CR-55947) OTS: $2.60 ph, $1.01 mf

This report presents experimental resonant frequencies and damping ratios for 45°, 60°, and 90° compartmented tanks. These are presented for various sector wall configurations and translational excitation amplitudes. Author

N64-17678* General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
FLUID AMPLIFIER STATE OF THE ART, VOLUME I Phase I Report
3 Dec. 1963 294 p refs Work performed together with GE Co., Johnson City, N.Y.
(NASA Contract NAS8-5408)
(NASA CR-55906) OTS: $18.50 ph, $9.02 mf

The report surveys the current state-of-the-art of fluid amplifiers including both theoretical and practical aspects of devices having no mechanically moving parts. It is based on a complete review of the published literature (with an extensive bibliography), and on information obtained from 20 organizations involved in fluid amplifier development. Specific areas covered are design techniques, both analytical and experimental; typical elements and assemblies; applications, both now in use and contemplated; fabrication techniques; and instrumentation. Author

N64-17679* General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
FLUID AMPLIFIER STATE OF THE ART. VOLUME II – BIBLIOGRAPHY [1935-1963] Phase I Report
3 Dec. 1963 124 p 317 refs Work performed together with GE Co., Johnson City, N.Y.
(NASA Contract NAS8-5408)
(NASA CR-55907) OTS: $10.10 ph, $3.92 mf

This bibliography concerns itself with the state-of-the-art of the fluid amplifier. It covers functional descriptions and surveys; basic fluid flow; vortex flow; assemblies; elements, design, and performance; instrumentation and flow visualization; fabrication techniques; response; applications; and patents. C.L.W.

N64-17780 Hydronautics, Inc., Laurel, Md.
ON THE ROLE OF CORROSION IN CAVITATION DAMAGE
Sophia Waring, H. S. Preiser, and A. Thiruvengadam Feb. 1964 37 p refs
(Contract Nonr-3755(00) FBM)
(Tech. Rept. 233-4; AD-433061)

The interacting influence of corrosion on cavitation damage was studied quantitatively using a magnetostrictive device. The relationship between the rate of weight loss and the amplitude of oscillation for 1020 mild steel became modified as the NaCl concentration was increased. When 1100-F aluminum was used, this relationship was not affected. An attempt was made to estimate the contribution of electrochemical corrosion to total damage by four methods: (1) static polarization measurements; (2) dynamic polarization measurements; (3) short-duration pulsing technique; and (4) long-duration pulsing technique. The electrochemical corrosion rates thus estimated are very small compared to the total rate of damage. Author

N64-17792* Ling-Temco-Vought, Inc., Dallas, Tex.
ON THE TURBULENT SHEAR FLOW OF AN ELASTICOVISCOUS FLUID
C. S. Wells Dec. 1963 43 p refs Presented at the AIAA Aerospace Sci. Meeting, New York, 20–22 Jan. 1964
(NASA Contract NASw-729)
(NASA CR-53319; Rept. 0-71000/3R-28) OTS: $4.60 ph, $1.49 mf

General categories of possible fluid systems are described, including Newtonian, purely viscous non-Newtonian, and elasticoviscous non-Newtonian. Turbulent shear flow of real elasticoviscous fluids and the relation of these fluids to the aerospace sciences and technologies are discussed. An analysis of this problem is presented in terms of viscous fluid properties, the Prandtl mixing length concept, and a stability criterion. Experiments are described that provide data on frictional drag and velocity profiles in fully developed pipe flow of several fluids presumed to be elasticoviscous. The experimental results are compared to the analysis with respect to thickness of the viscous sublayer, shape of the velocity profile, variation of the mixing length constant, and effects of pipe diameter. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-16932 National Physical Lab., New Delhi (India)
RADIO PROPAGATION UNIT Sci. Rept. 13
Santosh Aggarwal 15 Dec. 1963 20 p refs
(RPU-S13)

A reexamination is made of the problem of bifurcation of the F-layer produced by a single ionization process and a height-dependent loss coefficient. A model of a recombination coefficient gradually varying with height, together with a Chapman-like production function, gives results more in conformity with observed values of the parameters (particularly near the magnetic equator) than those obtained previously with an idealized step-function model of a recombination coefficient. It is also found that the F1 peak would appear only when the height of the peak of electron production is quite low, being around 150 km during midday. Author

N64-16933 National Physical Lab., New Delhi (India)
RADIO PROPAGATION UNIT Sci. Rept. 14
A. P. Mitra, B. C. Narasinga Rao, and K. K. Mahajan 30 Dec. 1963 18 p refs
(RPU-S14)

A new method for the estimation of the loss coefficient β and the vertical drift velocity v for the ionospheric F-region using the electron density–true height data is developed without making major assumptions. Representative height distributions of β and v are given. Author

N64-16957 Chicago U., Ill. Labs. for Applied Sciences
MULTICOLOR ATMOSPHERIC MODELS
Richard J. Kauth Sep. 1963 14 p refs
(ARPA-SD-71)
(LAS-TR-199-49; AD-419045)

It is the purpose of this paper to prepare the groundwork for the computation of the joint probability density function of apparent radiances in several spectral regions, seen looking down at the atmosphere from above. Author

N64-16978 Texas U., Austin Electrical Engineering Research Lab.
CALCULATED REFRACTIVE INDICES FOR SMALL-AMPLITUDE GEOMAGNETIC DISTURBANCES
Carroll W. Chapman, Bob M. Fannin, and Billy G. Gray 15 Dec. 1963 71 p refs
(Contract AF 19(604)-8038)
(Rept. 6-58; AFCRL-64-228; AD-430888)

The results of numerical computations of the refractive indices for the three modes of hydromagnetic wave propagation existing in the earth's upper ionosphere and outer atmosphere in the frequency range 10^{-3} to 10 cps are presented. These results are derived from a small-amplitude, collisionless, fully-ionized plasma model in which the effects of scalar, adiabatic pressure variations, finite conductivity, and displacement currents in the plasma constituents are taken into account. Also included are: (1) the dispersion relation for a homogeneous medium; (2) some results of numerical calculations of the refractive indices in terms of dimensionless parameters; (3) the refractive indices for selected altitudes in a quiescent earth atmosphere; and (4) consideration of some elementary aspects of the ray-tracing problem. R.T.K.

N64-17003 Queen's U., Belfast (Northern Ireland)
DIURNAL VARIATION OF THE TEMPERATURE OF THE THERMOSPHERE
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 2-9 refs (See N64-17002 09-23)

A simple derivation of the heat conduction equation for the thermosphere is presented, and a method by which it may be solved numerically is described. Author

N64-17005 Queen's U., Belfast (Northern Ireland)
DETERMINATION OF THE TEMPERATURE OF THE UPPER ATMOSPHERE FROM THE PROFILES OF NIGHTGLOW EMISSIONS USING A FABRY-PEROT PRESSURE SCANNING INTERFEROMETER
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 14-18 refs (See N64-17002 09-23)

The 7-cm-aperture Fabry-Perot pressure scanning interferometer has been in an operational state at L'Observatoire de Haute Provence during the period October to December 1962. Over the period, 40 profiles have been obtained for 5,577 and 6,300 nightglow emissions. The deduced temperatures ranged from 500° to 1,200° K for the enhanced predawn and posttwilight periods in the case of the 6,300 A emission of OI. Author

N64-17192 Ghana U., Legon
EQUATORIAL STUDY OF IRREGULARITIES IN THE IONOSPHERE Final Report, 1960-1963
B. R. Clemesha, G. S. Kent (Ibadan U.), J. R. Koster, and R. W. Wright (West Indies U.) Aug. 1963 67 p refs
(Contract AF 61(052)-421)
(AFCRL-63-532; AD-430914)

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2. GROUP-DELAY MEASUREMENTS ON THE 16.570 Mc/s. PULSED TRANSMISSIONS FROM FREIBURG B. R. Clemesha and R. W. H. Wright p 2-3
3. AN INVESTIGATION OF IRREGULARITIES IN THE NIGHT-TIME EQUATORIAL F REGION G. S. Kent and J. R. Koster p 3-4
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7. AN INVESTIGATION OF THE IRREGULARITIES IN THE IONOSPHERE ASSOCIATED WITH EQUATORIAL TYPE SPREAD-F B. R. Clemesha p 7-50 refs (See N64-17193 09-12)

N64-17193 Ghana U., Legon
AN INVESTIGATION OF THE IRREGULARITIES IN THE F REGION ASSOCIATED WITH EQUATORIAL TYPE SPREAD-F
B. R. Clemesha *In its* Equatorial Study of Irregularities in the Ionosphere Aug. 1963 p 7-50 refs (See N64-17192 09-12)

The results are given of an investigation of spread-F irregularities, using a backscatter radar operating on a frequency of 18 mc. The irregularities are shown to occur in patches that extend over distances of up to 400 km in the east-west vertical plane. Seasonal and nocturnal variations in the occurrence of irregularities are given, and it is shown that variations in their height closely follow variations in the height of the F-layer. The drift velocity of patches of irregularities is shown to be of the order of 100 m/s towards the east. Author

N64-17198 Weather Bureau, Washington, D.C.
EARTH ENVIRONMENT EFFECTS
S. Fred Singer *In* Md. U. Proc. of the Space Communications Inst., Md. U., College Park, Jun. 23-28, 1963 1963 p 52-63 (See N64-17194 09-08) OTS: $9.10 ph, $3.50 mf

The earth's magnetosphere covers the region in which ionized gas (plasma) plays an important part in the dynamics of the atmosphere, and therefore, the geomagnetic field occupies an important role. The magnetosphere begins, by convention, at the maximum of the F-layer of the ionosphere, at about 250 km and extends out to perhaps 10 to 15 earth radii. Throughout most of the magnetosphere, the ions are in thermal equilibrium and form essentially a barosphere that obeys the hydrostatic equation. The temperature of the thermosphere portion of the magnetosphere is determined mainly by the absorption of solar UV. The absorption of a UV photon creates a photoelectron that has considerable energy; many of these are effectively trapped by the magnetic field and follow the line-of-force to the other hemisphere. As a result, there must exist a corona of hot electrons in the magnetosphere that may provide the seeds for the high-energy trapped electrons. Protons between 10 to 700 Mev are located mainly in the lower part of the magnetosphere along the lines-of-force that extend up to a latitude of 50° I.v.L.

N64-17233 Ohio State U., Columbus Inst. of Geodesy, Photogrammetry and Cartography
NEW ISOSTATIC TABLES FOR THE REDUCTION OF GRAVITY VALUES CALCULATED ON THE BASIS OF AIRY'S HYPOTHESIS

W. A. Heiskanen (Helsinki Tech. U.) Repr. from Publ. Isostat. Inst. Intern. Assoc. Geod. (Helsinki), no. 2, 1938 p 3–43 refs

These isostatic reduction tables were calculated for the thicknesses of the earth's crust corresponding to zero elevation, 20 km, 30 km, 40 km, and 60 km. The computation of the tables took place on the basis of the following assumptions: (1) The compensation is complete in terms of mass and each separate zone (zones A to G being considered as one zone), as a whole, is floating in the underlayer. (2) The compensation mass lies directly beneath mountains and oceans, respectively. (3) The density of the "continental layer" is everywhere and for every depth = 2.67, and that of the underlayer is everywhere and for every depth = 3.27, hence the difference between the densities of the underlayer and the continental layer is 0.6. (4) The thickness of the earth's crust corresponding to zero elevation, 20 km, 30 km, 40 km, and 60 km is assumed to be constant in all parts of the earth. I.v.L.

N64-17245 Joint Publications Research Service, Washington, D.C.

CALCULATION OF THE EFFECT OF REFRACTIVE BOUNDARY CURVATURE WHEN INTERPRETING SEISMIC SOUNDING DATA

S. V. Krylov and N. N. Puzyrev 19 Mar. 1964 20 p refs Transl. into ENGLISH from Geol. i Geofiz. (Novosibirsk), no. 11, Nov. 1963 p 3–17

(JPRS-23759; OTS-64-21835) OTS: $0.50

This article examines the problem of the distorting effect of a discontinuity curvature on the results of seismic sounding by refracted waves. The basis is provided for the methods of calculating the distortions that arise. Author

N64-17319 Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

ANALYSIS OF MAGNETOTELLURIC MICROPULSATIONS AT WIDELY SEPARATED STATIONS

Roy L. Komack (M.S. Thesis) Jan. 1964 61 p refs

(AFCRL-64-10; AD-430046)

An investigation of ultralow-frequency electromagnetic signals, known as magnetotelluric micropulsations, was made The electric field strength at the earth's surface was measured by means of electrodes placed in the ground. Analog paper chart records of these signals were made at Trinidad, B.W.I., Puerto Rico, and Austin, Texas. These records were later hand-digitized. The power spectra of the signals at each station were computed for a data sample three-quarters of an hour long. Certain power spectral peaks in the frequency range from 0.01 cps to 0.25 cps were noted. Several previously undiscovered regularities in the spectra of this sample were found. Power spectral peaks occurred at 0.05, 0.125, 0.175, and 0.225 cps. Also computed were coherencies between signals at all stations. Coherencies above 0.8 were found between signals recorded at stations more than 2,000 miles apart. The regular features found in the power spectra were also noted in the coherencies. In addition, some spectral line splitting that was not obvious in the power spectra appeared in the coherencies. Author

N64-17323 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Dept.

SOME OBSERVED SHORT TERM AND DIURNAL VARIATIONS OF STRATOSPHERIC DENSITY ABOVE 30 KM

Otto W. Thiele Feb. 1964 23 p refs

(ERDA-114; AD-432023)

Some observed variations of atmospheric density between 30 and 65 km over a short time period, including night–day variations, are presented. Five density profiles, three in darkness and two in daylight, were obtained with meteorological sounding rockets over a 48-hour period. The temperature was measured directly with a 0.32-mm bead thermistor, and the atmospheric density was derived using the hypsometric formula. Recent correction techniques have reduced density errors to 2% up to 55 km, approximately 2.5% from 55 to 60 km, and within 3% from 60 to 65 km. Over the altitude range examined, the most significant variations in density occur in the region of 45 to 60 km. Author

N64-17361 Smyth Research Associates, San Diego, Calif.

TARGET ACCURACY EXPERIMENT

L. R. Hughes, J. H. Gibbs, and L. A. Morgan Feb. 1964 320 p refs

(Contract AF 30(602)-2084, Change B)

(SRA-356; RADC-TDR-63-460; AD-432414)

The earth's atmosphere distorts the radio view of space vehicles as seen from the earth's surface. The limitations placed on an observer's ability to position and locate objects in space as a consequence of this distortion are the subject of the reported investigations. A detailed experimental program was pursued to measure particularly the elevation angle errors incurred in making space target measurements from the earth's surface when viewing near the horizon. Signals originating in artificial earth satellites were viewed through the distorting atmospheric medium and analyses performed to define the observed distortions as a function of space, frequency, and time. Simultaneous multi-frequency, multi-interferometer measurements allowed the data to be analyzed so as to describe separately the tropospheric and ionospheric components to the total sighting error angle. Methods of analysis are described which are applicable to predicting error or correcting position measurements on the basis of meteorological and ionogramic data. Author

N64-17444 General Electric Co., Schenectady, N.Y. Advanced Technology Labs.

APPLICATION OF ELECTRO OPTICS TO AURORAL STUDIES Final Report

J. F. Spalding and J. E. Anderson Dec. 1963 57 p

(Contract AF 19(628)-2366)

(AFCRL-64-209; AD-432157)

An investigation was performed to examine the feasibility of obtaining information on the changing characteristics of the aurora and night airglow by low-light-level image orthicons (I.O.). Although it was a poor year for auroras, scene movies and spectral lines were simultaneously photographed of various displays from the I.O. monitor and compared with photographs taken by other people. The image orthicon is faster by about three orders of magnitude over film. Night airglow spectra were adequately received with 8-second exposures, and 100 photons are sufficient to record a line, even considering grating loss, etc. Author

N64-17462 Columbia U., Palisades, N.Y. Lamont Geological Observatory

SEISMIC SIGNALS ON THE DEEP OCEAN FLOOR

David D. Prentiss 31 Aug. 1963 20 p

(Contract AF 19(604)-8357; ARPA Order 180-61; Proj. Vela-Uniform)

(Sci. Rep. 25; AFCRL-63-904; AD-431180)

An investigation has been undertaken to determine the potential use of hydrophones on the deep ocean bottom for the detection of seismic energy. In a study of earthquakes and microseisms, low-frequency amplifiers were installed, and

recordings were made at intervals for 10 March 1963 through 24 September 1963. A total of 80 days of recordings were obtained. Approximately 50 earthquakes can be recognized in these records. A partial listing of the recorded more distant shocks is given. A discription and preliminary analysis of the passage of Hurricane Arlene are also included. The problems associated with detecting induced signals are discussed. A film recorder for obtaining microseism data at the ocean bottom and the lunar telemetering bottom seismograph are described. R.T.K.

N64-17499 Joint Publications Research Service, Washington, D.C.

DETERMINING THE EPICENTERS OF DISTANT EARTHQUAKES BY POLAR AND SLIDING RECTILINEAR EPICENTRALS

A. A. Treskov 20 Mar. 1964 8 p ref Transl. into ENGLISH from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), no. 11, Nov. 1963 p 128–131
(JPRS-23770; OTS-64-21841) OTS: $0.50

An equation is given from which the polar rectilinear epicentral of earthquakes can be determined. In order to judge the accuracy of the determinations made by using this formula, the results for three earthquakes, from which data from the Strasburg bulletin were available, are compared. R.T.K.

N64-17506 Air Force Cambridge Research Labs., Bedford, Mass.

OBSERVATIONS OF IONOSPHERIC BEHAVIOR DURING THE SOLAR ECLIPSE OF 20 JULY 1963 AT BEDFORD, MASSACHUSETTS

Richard J. Miner Jan. 1964 18 p refs
(AFCRL-64-24; AD-432045)

Observations of the ionosphere during the July 20, 1963, solar eclipse at Bedford, Massachusetts, are presented. A C-4 vertical incidence sounder was used. Critical frequencies and virtual heights of the ionosphere are plotted and compared with a 10-day average curve. Ionograms of the time of first contact, maximum eclipse, and fourth contact are included. A series of optical photographs of the sun in eclipse, taken at ground level, are presented. Author

N64-17564* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EVIDENCE FOR THE EFFECT OF CORPUSCULAR RADIATION ON THE IONOSPHERE

F. Mariani (Rome U.) Repr. from J. Atmospheric Sci., v. 20, no. 6, Nov. 1963 p 479–491 refs Previously published as NASA TM X-51058. See N64-10297 01-28
(NASA RP-144)

The correlation of maximum electron density in the F region at noon, with solar activity, is investigated for both long-term and month-to-month variations, in data for 1937 to 1957 from all existing observatories. On the basis of noon equilibrium between electron loss and ion production by solar radiation, an ionizing effect, strongly dependent on solar activity and peaked at latitudes of 55 to 65 deg, is shown to exist. This latitudinal variation suggests a corpuscular origin of the effect. The possible source of a corpuscular flux is discussed. The energy of the ionizing particles is in the range of Kev. Quantitative evidence is given that Van Allen belts could be an important, or possibly the main, source. Author

N64-17574* New Hampshire U., Durham

EXPLORER XII OBSERVATIONS OF MAGNETIC SUDDEN IMPUSES IN THE EARTH'S MAGNETOSPHERE

Atsuhiro Nishida (Chicago U.) and J. H. Young [1963] 9 p refs
(NASA Contract NASw-155; NSF Grant GP-797)
(NASA CR-53231) OTS: $1.10 ph, $0.80 mf

The successful operation of the flux-gate magnetometer on board Explorer XII made possible a correlational study of geomagnetic field observation of ground-based magnetometers with the satellite observations at geocentric altitudes ranging from about 3 to 13 earth radii. The Explorer XII magnetometer recorded the field approximately 3 times per second. Two examples of Explorer XII magnetic records at the time of worldwide sudden impulses on the ground are presented. The first case is one of a positive sudden impulse (i.e., a worldwide increase in the field intensity). The second case is one of a negative sudden impulse (worldwide decrease in the field intensity). R.T.K.

N64-17579* Iowa State U., Iowa City

AN EXPERIMENTAL STUDY OF CHARGED PARTICLES IN THE OUTER RADIATION ZONE

L. A. Frank, J. A. Van Allen, and H. K. Hills Jan. 1964 54 p refs
(NASA Grant NsG-233-62)
(NASA CR-53169; SUI 64-1) OTS: $5.60 ph, $1.82 mf

Studies of the charged-particle fluxes near the magnetic equatorial plane in the vicinity of the outer-radiation zone, based on five months of data from Explorer XIV, are presented. The spectra, fluxes, radial distributions, and temporal variations of the charged particles detected are discussed and presented graphically. Typical electron fluxes measured in the heart of the outer zone are $J_o(E_e \geq 40 \text{ Kev}) = 3 \times 10^7 (\text{cm}^2\text{sec})^{-1}$. $J_o(E_e \geq 230 \text{ Kev}) = 3 \times 10^6 (\text{cm}^2\text{sec})^{-1}$; $J_o(E_e \geq 1.6 \text{ Mev}) = 3 \times 10^5 (\text{cm}^2\text{sec})^{-1}$. The integral energy spectrum of electrons over this range may be represented by $E^{-1(\pm 0.5)}$ at $L=4.8$ for most of the period investigated. The gross temporal variations of electron ($E \geq 40$ Kev), ($E \geq 230$ Kev), and $E \geq 1.6$ Mev) fluxes were by a factor of ~ 100, ~ 10, and ~ 100, respectively. A positive correlation between K_p daily sums and equatorial fluxes of electrons ($E \geq 40$ Kev) is demonstrated. Slow, inward radial motion of energetic ($E \geq 1.6$ Mev) electrons was observed after periods of geomagnetic activity. The effects of Soviet nuclear bursts of late October and early November 1962 on the natural radiation fluxes are discussed. At $L = 3.2$ near the equator, the flux of protons ($E \geq 500$ Kev) was $7 \times 10^6 (\text{cm}^2\text{sec})^{-1}$, and the flux of electrons ($E \geq 40$ Kev) was $3 \times 10^7 (\text{cm}^2\text{sec})^{-1}$, with no temporal variations within the experimental error of a factor of 2 or less. M.P.G.

N64-17602* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EXPLORER VIII SATELLITE MEASUREMENTS IN THE UPPER IONOSPHERE

R. E. Bourdeau and J. L. Donley Aug. 1963 45 p refs Presented at the Roy. Soc. Conf., London, 2–3 May 1963 Submitted for Publication
(NASA TM X-54573; X-615-63-165) OTS: $4.60 ph, $1.55 mf

This report covers upper-ionospheric ion composition, spacecraft-plasma interaction, and electron temperature, all measured by using the Explorer VIII satellite. Among the topics discussed are: (1) the potential of the Explorer VIII satellite; (2) measurements of plasma-to-satellite ion current; (3) measurements of plasma-to-satellite electron current; (4) elimination of interaction effects in deriving geophysical parameters; (5) a summary of ion composition results; and (6) a summary of electron-temperature results. R.T.K.

N64-17612* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DEVELOPMENT OF THE EARTH'S GRAVITATIONAL POTENTIAL FROM THE SIXTH THROUGH THE TWELFTH ZONAL HARMONIC
Theodore L. Felsentreger Dec. 1963 10 p refs
(NASA TM X-51281; X-547-63-269) OTS: $1.10 ph, $0.80 mf

The purpose of this report is to express that part of the earth's gravitational potential from the sixth zonal harmonic through the twelfth, along with its partial derivatives with respect to an inertial geocentric coordinate system, in a form suitable for inclusion in the numerical integration of position partial derivatives for an earth satellite. Values for the harmonic coefficients are also given. Author

N64-17634 Canterbury U., Christchurch (New Zealand)
GEOMAGNETIC MICROPULSATIONS AT CHRISTCHURCH, NEW ZEALAND Final Report
B. J. Fraser, P. W. Mc Nabb, and C. D. Ellyett Aug. 1963 75 p refs
(Contract Nonr(G)-00027-62)
(AD-433505) OTS: $7.60

The current program status includes the following: (1) Micropulsation equipment was built to test the validity of the claim made by several authors that meteors entering the earth's upper atmosphere produced micropulsation bursts at ground level. Results failed to show a correlation. (2) The micropulsation recording apparatus was almost completely rebuilt. The resulting broadband equipment covers the frequency range of 0.008 to 0.25 c/s to 3 db points below the maximum response. (3) Further comparison studies were conducted of meteors and nighttime micropulsations in the 1.5-c/s frequency band. The sensitivity of 0.05 m γ appears to be of the same order of magnitude as the highest sensitivities so far reported in the literature. (4) A micropulsation effect due to the high-altitude nuclear explosion of July 9, 1962, at Johnston Island, was observed at Christchurch. (5) Continuous, routine broadband observations were begun on October 16, 1962, and all charts up to July 1963 have been read. (6) A completely transistorized portable high-gain micropulsation unit is well under construction, and will be taken to remote sites to compare the diurnal activity against the results from the fixed unit. I.v.L.

N64-17735 Joint Publications Research Service, Washington, D.C.
NATURAL RADIOACTIVITY OF SOILS
V. I. Baranov 27 Mar. 1964 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), v. 29, no. 1, 1964 p 159–163
(JPRS-23912; OTS-64-21919) OTS: $0.50

The method of appraising the artificial radioactivity of the soil, based on the difference of total emission and on the emission of potassium, and computed according to its content in the soil, can be considered as worthwhile. For obtaining data on the quantitative content in the soil of specific radioisotopes, it is necessary to use chemicoanalytical or radiochemical methods. The usual radiometric methods without nuclear spectroscopy cannot replace the quantitative determination of the basic components of natural radioactivity of soils (U, Th, K). The conclusion obtained on the basis of evidence of radiometric devices may not correspond to the actual picture and loses its scientific significance. Author

N64-17774* National Aeronautics and Space Administration, Washington, D.C.
AURORAE AND AIRGLOW – RESULTS OF IGY RESEARCH
P. Ya. Sukhoivanenko et al Apr. 1964 117 p refs Transl. into ENGLISH of "Polyarnyye slyaniya i svecheniye nochnogo neba: Resul'taty issledovaniy po programme mezhdunarodnogo geofizicheskogo goda", no. 7 Moscow, Izd. AN SSSR, 1961 (NASA TT F-117) OTS: $2.50

This is a collection of articles on the results of observations of auroras and airglows. Some of the papers present results of observations on a global scale, and others are on a scale covering a considerable part of the Soviet Arctic. Also included is an article on the interferometic investigation of the green oxygen line. Author

N64-17784 Pennsylvania State U., University Park Ionosphere Research Lab.
A METHOD FOR OBTAINING INSTANTANEOUS VALUES OF RECOMBINATION COEFFICIENT
A. P. Mitra 1 Feb. 1964 39 p refs
(Contract AF 19(628)-3842; NSF Grant G-18983; Contract DASA-WEB 07.010)
(PSU-SR-204; AFCRL-64-31; AD-432872) OTS: $3.60

A method is introduced for obtaining the instantaneous values (as against "comparison" values given by current methods) at layer maxima, applicable principally for the E and the F_1 regions. It is shown that an application of this method to the E-region critical-frequency data of a number of medium- and low-latitudes stations gives remarkably small diurnal variations of the coefficient at E-region heights in contrast with the large diurnal variation obtained by the "comparison" methods. Another feature of the results is that the diurnal variations for both high and low latitudes are in the same sense, and there is no definite evidence of a phase reversal. Author

N64-17789* New Hampshire U., Durham
PRELIMINARY RESULTS OF MAGNETIC FIELD MEASUREMENTS IN THE TAIL OF THE GEOMAGNETIC CAVITY
Laurence J. Cahill, Jr. [1963] 10 p refs
(NASA Contract NASw-155)
(NASA CR-53342; UNH-63-1) OTS: $1.10 ph, $0.80 mf

A discussion is presented of data obtained by the Explorer 14 satellite. From the data, it is tentatively concluded that the magnetic field remains essentially that of a centered dipole, with minor distortions, out to a distance of 8 to 10 earth radii. The distance apparently varies from day to day. Beyond this distance, the field remains at a level of 30 to 60 gammas, with relatively small, short-term (period less than 1 hour) fluctuations in magnitude. Slow time variations may be present, with changes of 20 to 30 gammas occurring in periods of several hours, although they cannot be distinguished from spatial variations along the satellite orbit. The direction of the field changes from the dipole direction at 6 to 10 earth radii to a direction $\psi = 180°$, $\alpha = 140°$ within a transition distance of 2 to 4 earth radii. When the transition starts at a closer distance, the changes appear to occur more rapidly. Once the field direction reaches the mentioned values, the average direction and magnitude remain quite constant out to an apogee beyond 16 earth radii. P.V.E.

N64-17799 Geophysics Corp. of America, Bedford, Mass.
CALCULATION OF THE SPATIAL DIFFUSION OF SMALL PARTICLES IN AN EXPONENTIAL ATMOSPHERE
Milton M. Klein, Kwang Yu, and Richard H. Harrison Jun. 1963 20 p refs
(Contract DA-49-146-XZ-075; ARPA Order 188-61)
(GCA-TR-63-5-G; DAS-1400; AD-434009) OTS: $1.60

Previously, in obtaining analytic solutions for both three-dimensional and one-dimensional motion in atmospheres

having exponential and parabolic intensity distributions, numerical work was confined to the one-dimensional problem for the exponential atmosphere. In this paper, calculations are extended to the three-dimensional problem. Some typical results are presented as graphs. From the relative density contours, it is noted that the heavier particles exhibit a more rapid dropoff in density, regardless of the altitude, than do the lighter particles. From the absolute density contours, it is noted that, as the altitude becomes lower, the densities for the heavier particles are greater than those for the lighter particles. A comparison of these contours indicates a very rapid spreading out of the lighter particles and the extremely small dispersion for the heavier particles. E.K.R.

N64-17831* National Aeronautics and Space Administration, Washington, D.C.
THE MEASUREMENT OF UPPER-AIR DENSITY AND TEMPERATURE BY TWO RADAR-TRACKED FALLING SPHERES
J. W. Peterson and K. D. Mc Watters (Michigan U.) Apr. 1964 49 p refs
(NASA Contract NASw-138)
(NASA CR-29) OTS: $1.50

Two major lines of investigation have been pursued: the measurement of neutral composition with mass spectrometers, and the measurement of neutral density with falling spheres. The purpose of the work described in this report was to develop an inexpensive technique for probing the atmosphere at relatively high levels using a lightweight sphere to be tracked by radar. Two such systems were developed and successfully flown on Nike–Cajun rockets. The first system employed dual pods, arranged in the Cajun tail section for rearward deployment of two inflatable spheres. The second system employed a single tube in the Cajun nose cone for forward deployment of a single inflatable sphere. Author

N64-17833 Joint Publications Research Service, Washington, D.C.
TELLURIC BAYS AND DISTURBANCES
6 Apr. 1964 22 p refs Transl. into ENGLISH from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), no. 12, Dec. 1963
(JPRS-24049; OTS-64-21993) OTS: $0.75

Results are presented that support the close connection between the activities of the geomagnetic and telluric fields; the regularities of the daily, seasonal and cyclical changes in magnetic activity, established earlier for the middle latitudes, were also observed in the changes in the telluric field. It has been shown that both components of the electromagnetic field of the earth are subordinate to common statistical regularities. Author

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-16929* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
WALL TEMPERATURES IN A TUBE WITH FORCED CONVECTION, INTERNAL RADIATION EXCHANGE, AND AXIAL WALL HEAT CONDUCTION
Robert Siegel and Edward G. Keshock Washington, NASA, Mar. 1964 42 p refs
(NASA TN D-2116) OTS: $1.00

An analysis is presented in which a circular tube with uniform wall heat generation is cooled by a turbulent forced convection gas flow. The wall temperature is determined by taking into account the effects of: (1) convective heat addition from the tube wall to the flowing gas, which includes a varying heat-transfer coefficient in the thermal entrance region; (2) radiation exchanges between wall elements on the internal surface of the tube; and (3) axial heat flow by conduction along the tube wall. The flowing gas is assumed transparent to radiation, and, hence, does not participate in the radiative exchange process. It is assumed that the outside surface of the tube is perfectly insulated and the inside surface is a black radiator. The resulting nonlinear integrodifferential equation is solved by a specially devised iterative technique, and a number of illustrative solutions are given. Author

N64-16931* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
A THEORY OF SPACE-PROBE ENTRY UNDER CONDITIONS OF HIGH MASS LOSS
Frederick C. Grant 1963 20 p refs
(NASA TR-R-162) GPO: $0.30

The atmospheric entry of probes suffering high mass loss is described in terms of the solutions of a derived second-order nonlinear differential equation, the size–altitude equation. Upper bounds on entry velocity are established as functions of payload fraction. An intrinsic limitation of probe size is established that is related to the finite depth of the atmosphere. Variations of trajectory properties of interest with probe geometry, heat-protection material, and heat input function are indicated. The class of shapes considered is that of truncated cones, with cylinders and initially pointed cones as limiting cases. Insertion of reasonable physical properties and heat inputs into the analysis indicates that significant payload fractions can survive entry at speeds beyond 10^5 fps. Author

N64-17017* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
TWO NEW FREE-FLIGHT METHODS FOR OBTAINING CONVECTIVE-HEAT-TRANSFER DATA
Dale L. Compton and Gary T. Chapman *In* Am. Inst. of Aeron. and Astronautics AIAA Aerodyn. Testing Conf. [1964] p 115–128 refs (See N64-17013 09-01) AIAA: $5.00 members, $10.00 nonmembers

In the catcher–calorimeter technique, models are gun-launched into the pressurized ballistic range at velocities from 4,300 to 11,000 fps, allowed to decelerate aerodynamically to a few hundred feet per second, and caught. The total aerodynamic heat input to the models is measured in a calorimeter. Extreme care is taken to account for and minimize all extraneous sources of heat addition or loss. In the melting-onset technique, aluminum hemispheres are gun-launched into the prototype of the hypersonic free-flight facility at a velocity of 24,000 fps into still air, and at a combined velocity of 36,000 fps into the countercurrent airstream. At some point on the flight path, the model begins to melt, and molten aluminum streams from the model surface into the wake where it

can be detected in shadowgraphs. The stagnation-point heating rate is then deduced by computing the heating rate required to produce melting at the observed time. Author

N64-17032 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DETERMINATION OF THE THERMODYNAMIC PARAMETERS OF CHROMIUM AND COBALT BY MEASUREMENT OF THE SATURATED VAPOR PRESSURE OF CHROMIUM
Ya. I. Gerasimov, A. M. Yevseyev, and G. V. Pozharskaya *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 94–102 refs (See N64-17026 09-18)

The results of experiments to determine the saturated vapor pressure of chromium were processed according to the equation $\lg P = -A/T + B$. The data coincided closely with the lines $\log P = -1/T$ within the temperature range 1,227° to 1,297°. Discrepancies between the calculated and the experimental values of P did not exceed 5%. The saturated vapor pressure of chromium for alloys of various chromium concentrations at 1,500°, 1,525°, and 1,550° K were calculated. From this data the activity of chromium was determined, and the results along with the partial molar heat of combination of chromium are presented in tabular form. In the zone of the solid solution based on Co_2Cr_3 (0.56 to 0.62 mole fractions of chromium) a sharp decline in activity takes place, and the partial heat of diffusion of chromium changes its sign from negative to positive. It was found from the data on the integral heats of formation of cobalt–chromium alloys that the formation of Co_2Cr_3 is accompanied by heat absorption (3,100 large cal.). The maximum loss of energy during the formation of cobalt–chromium alloys is sustained by alloys containing 0.85 to 0.95 mole fractions of chromium. P.V.E.

N64-17033 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING THE VALUES OF ACTIVATION ENERGY OF CERTAIN PROCESSES IN METALS
K. A. Osipov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 103–115 refs (See N64-17026 09-18)

Some theoretical aspects of the activation energy and the experimental data concerned with it, are discussed. An analysis of the experimental data led to the conclusion that the activation-energy values for the most diverse phenomena involving the displacement of atoms and vacancies in solid metals (diffusion, recovery and recrystallization, plastic deformation and failure, shear planes, and displacement of dislocations) can be expressed by the equation $\Delta H = nq$, where n is the number of atoms in the activated group and q is the activation for one atom a in a group of n atoms in gram-atoms. P.V.E.

N64-17123 North American Aviation, Inc., Columbus, Ohio Engineering Dept.
DEVELOPMENT OF AERO-THERMODYNAMIC PROCEDURES FOR DESIGNING HIGH SPEED VEHICLE LEADING EDGES
J. K. Mc Cullough and W. E. Gamble [1963] 316 p refs
(Contract NOw-61-0719-t)
(NA63H-982; AD-431275)

A series of design charts is presented for symmetrical, blunted wedge and conical leading edges that enable the user to predict steady-state surface-temperature distributions of radiation-cooled nose sections while considering aerodynamic drag. The methods and design charts apply to flight speeds between Mach 2 and Mach 24, and altitudes between sea level and 220,000 ft. In addition, a sample structural analysis was conducted for two different leading-edge shapes of a swept wing being maintained at a flight condition of Mach 3.5 at 80,000 ft altitude. The results apply to aircraft, missiles, and glide reentry vehicles operating under quasi-steady flight conditions. Author

N64-17174 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CALCULATING RADIAL OVERFLOWS IN A TURBINE STAGE
G. V. Zhukovskiy *In its* Heat Power Eng. (Selected Articles) No. 8, 1962 2 Apr. 1963 p 1–11 refs (See N64-17173 09-01)

Experimental data are presented on the testing of flow-through sections of gas turbine stages with cylindrical boundaries and $D/l = 4.8$. A comparison was made with calculations using simplified and inverse equations of radial equilibrium. The difference between experiment and calculation reaches a noticeable magnitude along end sections, due to secondary end flows on the working wheel and to flow through the radial gap over the working vanes. Author

N64-17177 Air Force Systems Command, Wrignt-Patterson AFB, Ohio Foreign Technology Div.
CALCULATING THERMODYNAMIC PROPERTIES OF REAL GASES AT HIGH TEMPERATURES
A. G. Tabachnikov *In its* J. of Eng. Phys. (Selected Articles) v. 5, no. 9, Sep. 1962 5 Apr. 1964 p 1–10 refs (See N64-17176 09-01)

A method of extrapolating virial coefficients by temperatures was used in formulating an equation of state for nitrogen in the temperature range of 0° to 3,000° C. For densities of 0 to 360 amagat units, in this temperature range, the form of the equation of state is given. I.v.L.

N64-17184 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EFFECT OF JOULE HEATING ON HEAT TRANSMISSION AT THE CRITICAL POINT
V. A. Polyanskiy *In its* News of the Acad. of Sci. of the USSR, Dept. of Tech. Sci., Mech. and Machinery Manufacture (Selected Articles) 5 Apr. 1963 p 1–7 refs (See N64-17183 09-01)

From the equation of the magnetic hydrodynamics of an incompressible liquid, an expression is derived that demonstrates the influence of Joule heating on heat transmission. R.T.K.

N64-17189 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HEAT TRANSFER (SELECTED ARTICLES)
19 Aug. 1963 23 p refs Transl. into ENGLISH from the book "Teploperedacha" Moscow, Izd. AN SSSR, 1962 p 22–26 and 116–123
(FTD-TT-63-452/1+2+4; AD-418209)

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N64-17190 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE ENTROPY AND HEAT CAPACITY OF ALKALI METALS IN THE FUSED STATE

I. M. Pchelkin *In its* Heat Transfer (Selected Articles) 19 Aug. 1963 p 1–8 refs (See N64-17189 09-13)

Assuming that certain metals (Li, Na, K, Rb, and Cs) constitute a group of thermodynamically similar substances for which general principles should exist for both heat capacity and for other physical properties (viscosity coefficient, heat transfer, surface tension, and the heat of vaporization), it is shown that the entropy of thermodynamically similar substances should also be an identical function of these parameters. It is concluded that the data on the heat capacity of lithium, rubidium, and cesium, calculated according to the τ-s diagram, can be recommended for engineering calculations. P.V.E.

N64-17191 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE EFFECT OF CERTAIN SURFACE PROPERTIES ON THE BOILING CRISIS

V. I. Yashnov *In its* Heat Transfer (Selected Articles) 19 Aug. 1963 p 9–21 refs (See N64-17189 09-13)

The dependence of the critical heat flow on the nature of the machining and on the condition of the heating surface with bulk boiling of distilled water at atmospheric pressure was investigated. It is concluded that: (1) The values of the critical heat flow, q_{cr}, on fresh, technically smooth tubes of stainless steel, when large amounts of water are boiled at atmospheric pressure, are 2 to 3 times less than on those same tubes after preliminary boiling of water in them. (2) The time of stabilizing the values of q_{cr} during preliminary boiling decreases with an increase of the specific heat flow of the preliminary boiling. (3) The surface on which boiling occurs remains as though "hardened" when it is stored in the air. (4) The values of q_{cr} on freshly polished steel tubes are, on the average, 1.5 times less than on rough tubes with a height of unevenness of 0.04 to 0.08 mm. P.V.E.

N64-17281 California U., Berkeley Inst. of Engineering Research

LOCAL LEADING EDGE HEAT TRANSFER ON A FLAT PLATE IN RAREFIED HYPERSONIC FLOW

James D. Hendry (M.S. Thesis) 1 Dec. 1963 47 p refs
(Contract AF 33(657)-8607; Contract Nonr-222(45))
(AS-63-8; AD-431824) OTS: $4.60

The local heat flux to a sharp-edged flat plate was measured over the range $32.8 < Re_x < 4,486$ and $5.51 < M < 5.71$. The stagnation temperature was varied from approximately 77° to 2,000° F to give wall-to-stagnation-temperature ratios of from 0.501 to 0.121. The experimental data were compared to the theoretical strong interaction predictions and found to be approximately 65% higher. A slight indication of slip near the leading edge is found at $M_\infty \sqrt{C^*}/\sqrt{Re_x} \sim 0.5$. Author

N64-17294* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ONE-DIMENSIONAL HEAT-TRANSFER ANALYSIS OF THERMAL-ENERGY STORAGE FOR SOLAR DIRECT-ENERGY-CONVERSION SYSTEMS

Richard R. Cullom, William H. Robbins, and Carroll A. Todd Washington, NASA, Mar. 1964 28 p refs
(NASA TN D-2119) OTS: $0.75

A one-dimensional thermal-energy storage system was analyzed as a time-variant heat-conduction problem coupled with a change in state of the conducting medium. Solutions for nondimensional surface temperature and solidification depth are presented in graphic form for various modes of heat transfer from one surface of the material. Solutions were obtained by means of finite-difference equations with the assumption that the material was initially at the fusion temperature. Material property values were assumed constant with temperature, and internal heat generation was not considered. The general solutions were applied to the analyses of thermal-energy-storage systems utilizing silicon and lithium hydride. Analysis showed that the high heat of fusion of a thermal-storage material cannot be fully utilized unless the thermal conductivity is also of a relatively high value so that the thermal energy can be removed from the liquid–solid interface and can be conducted to the exterior heat-transfer surface with no excessive temperature drop. Author

N64-17333 Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.

MEASUREMENT OF HEAT FLUX IN SOLID PROPELLANT ROCKETRY

Charles E. Brookley Nov. 1963 55 p refs Presented at the 18th Ann. Conf. of Instr. Soc. of Am., Chicago, 9 Sep. 1963
(Contract NOrd-16640)
(ABL/Z-60; AD-432472) OTS: $5.60

A radiometer and slug-type calorimeters were designed, calibrated, and mounted flush with the inner surface of the internal chamber insulation of a solid-propellant rocket motor. During repeated static firing of this motor, the magnitude of the heat flux was measured and divided into radiant and convective components. Measurements were taken in the unit when using both aluminized and nonaluminized propellants. Author

N64-17335 Ohio State U. Research Foundation, Columbus Aerodynamic Lab.

MEASUREMENTS OF AERODYNAMIC AND RADIATIVE HEATING AT SUPER-ORBITAL VELOCITIES

Robert M. Nerem 15 Jan. 1964 51 p refs
(Contract AF 33(657)-10110)
(Rept. 1598-1; AD-432473) OTS: $5.60

Using an arc-driven shock-tube facility, measurements of aerodynamic and radiative stagnation-point heating have been carried out at simulated flight velocities ranging from 20,000 to 40,000 fps. The measurements of aerodynamic heating were performed using standard calorimeter techniques, and the radiative measurements were carried out through the use of a thin-film radiation heat-transfer gage. The present results indicate no significant ionization effects on aerodynamic heating and indicate that the Lees approximate equation for stagnation-point heat transfer can be used for engineering purposes for flight velocities up to 40,000 fps. The radiative heat-transfer measurements indicate that present estimates of radiative emission in the flight velocity range of 34,000 to 40,000 fps may be as much as a factor of 3 to 4 too high. Author

N64-17434 AeroChem Research Labs., Inc., Princeton, N.J.

DISSOCIATING GASES AS NATURAL CONVECTION COOLANTS

Daniel E. Rosner 18 Feb. 1964 13 p refs Submitted for Publication
(Contract AF 49(638)-1138; Gen. Motors Purchase Order G808789)
(TP-83; AD-430599)

Molecular dissociation was found to increase the effectiveness of gases as natural convection heat-transfer media largely by virtue of the attendant increase in thermal expansion coefficient β and in thermal conductivity λ, with the latter effect being the more important. Consequently, in temperature-limited systems, an optimum pressure level, strongly dependent on the strength of the bond being broken, will exist for maximum coolant effectiveness. Coolants in the dissociation region can be

ranked in accordance with a figure of merit derived from the thermophysical property groupings that enter the expression for the relevant convective heat-transfer coefficient. The results also indicate that fully enclosed, pressurized dissociating gases may be capable of transferring heat away from turbomachinery components at rates sufficient to enable the use of higher inlet total temperatures. R.T.K.

N64-17459 Little (Arthur D.), Inc., Cambridge, Mass.
STUDY OF HIGH TEMPERATURE THERMODYNAMICS OF LIGHT METAL COMPOUNDS Progress Report No. 8, 1 Oct.-31 Dec. 1963
Alfred Buchler 31 Dec. 1963 9 p refs
(Contract DA-19-020-ORD-5584; ARPA Order 40-62)
(C-64362; AD-432884)

The structure of a large number of high-temperature species, principally of the Y-X-Y type, was examined by a combination of electric deflection and mass spectrometric techniques. The principal conclusion derived from the results is that the simple considerations that have been used to interpret observed molecular geometry (such as the ionic model, or arguments based on atomic valence states) are not sufficient to permit the a priori prediction of the structure of any given group of XY_2 compounds. This study includes investigations of the group IIA, IIB, and IVB metals, and a number of fourth-row transition metal halides. R.T.K.

N64-17537 Callery Chemical Co., Pa.
THERMODYNAMIC PROPERTIES OF THE METAL BROMIDES, IODIDES, SULFIDES, SULFATES, CHROMATES, METAPHOSPHATES, ORTHOPHOSPHATES, MOLYBDATES, TUNGSTATES, BORATES AND HYDROXIDES Final Report, May-Dec. 1963
W. J. Cooper and D. A. Scarpiello Jan. 1964 57 p refs A literature survey prepared for Sandia Corp.
(SC-RR-64-67) OTS: $1.25

The thermodynamic properties of the metal bromides, iodides, sulfides, sulfates, chromates, metaphosphates, orthophosphates, molybdates, tungstates, borates, and hydroxides found in the literature through December 1963 have been tabulated. The free energies of formation of these compounds have also been plotted as a function of temperature. Author

N64-17563* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
CYLINDRICAL SECTIONS WITH UNIFORM DIFFUSE-RADIATION CHARACTERISTICS
Max. A. Heaslet and Franklyn B. Fuller Repr. from Intern. J. Heat Mass Transfer, v. 6, 1963 p 1049-1052 refs FRENCH and GERMAN summaries
(NASA RP-143)

Calculations are made that determine the cross-sectional shapes of cylindrical or two-dimensional cavities that exhibit uniform radiation characteristics when the interior surface is a diffuse emitter. Immediate applications arise for concave cylindrical radiators or grooves on the surface of an opaque material when temperature is held fixed and uniform emission or heat flux is desired. Geometric interrelations between these and similar results for axially symmetric concavities are determined. Author

N64-17576* California U., Berkeley Inst. of Engineering Research
EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF TRANSPIRATION COOLING ON A PARTIALLY DISSOCIATED TURBULENT BOUNDARY LAYER
R. N. Meroney (M.S. Thesis) 15 Nov. 1963 68 p refs
(NASA Contract NAS8-850)
(NASA CR-53247; AS-63-6) OTS: $6.60 ph, $2.24 mf

The convective heat transfer between a partially dissociated combustion gas and a flat plate cooled by light gas injection (hydrogen or helium) was investigated experimentally. Gases were injected through a porous stainless-steel test section instrumented with thermocouples to obtain local heat-transfer rates. These heat-transfer rates were computed from energy balances performed on the porous section undergoing steady-state heating. With injection of a light gas the local heat-transfer rate decreased rapidly to an essentially uniform value within six inches of the leading edge. Variation of the blowing parameter $F = \rho_0 v_0 / \rho_e v_e$ from 0.005 to 0.01 decreased this uniform value of the heat transfer by 100%. Comparison of results with previous data showed agreement for helium. However, hydrogen injection resulted in heat fluxes up to 100% greater than those measured by other investigators. Author

N64-17600* Minnesota U., Minneapolis
Summary of Research [RADIATION HEAT TRANSFER]
E. M. Sparrow [1963] 5 p refs
(NASA Grant NsG-137-61)
(NASA CR-53289) OTS: $1.10 ph, $0.80 mf

Investigations carried out in the following areas are described: (1) studies of the heat-transfer characteristics of space-vehicle radiators; and (2) studies of the radiation properties of surfaces. R.T.K.

N64-17613* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
INVESTIGATION OF PROBLEMS IN THERMAL CONVECTION: RIGID BOUNDARIES
Jackson R. Herring NASA. Goddard Space Flight Center [1963] 73 p refs
(NASA TM X-51241) OTS: $7.60 ph, $2.39 mf

Thermal convection equations for a thin layer of fluid were extended to include systems containing many horizontal wave numbers and obeying rigid boundary conditions on the conducting surfaces. A Fourier analysis is made of the equations of motion, and the Fourier components are allowed to evolve to their steady-state values from arbitrary initial conditions. In this calculation the Prandtl number is set to equal infinity. This choice of Prandtl number allows a simpler formulation of the problem in Fourier space and makes the transient behavior of the systems simpler. The solutions obtained in the present calculations for rigid boundaries and one horizontal wave number are qualitatively similar to the corresponding ones for free boundaries. C.L.W.

N64-17637 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
CRITICAL HEAT FLUXES DURING FLOW OF A WETTING LIQUID WITH A NUCLEUS, UNDERHEATED TO THE TEMPERATURE OF SATURATION
S. S. Kutateladze 3 Jan. 1964 21 p refs Transl. into ENGLISH from Energetika (Kharkov), no. 2, 1959 p 229-239
(RSIC-129; AD-432295)

The development of critical phenomena during the boiling of water that flows in an annular canal and a circular tube is approached through a hydrodynamic theory of the critical stages in the mechanisms of boiling. Basic assumptions and generalized relations of the hydrodynamic theory of critical stages in the boiling mechanism are given. Analysis was made of experimental data concerning the influence of underheat and saturation temperature on the value of the first critical density

of the heat flux. Analyses were also made of experimental data concerning the influence of liquid flow velocity on the value of the first critical density of heat flux. C.L.W.

N64-17672* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMODYNAMICS OF SPACE FLIGHT (HEAT TRANSFER PHENOMENA IN SPACE)
Milton Schach and Robert E. Kidwell, Jr. 25 Mar. 1963 53 p refs Lecture prepared for the Space Environ. Technol. Ser. conducted by Penn. State U. and Inst. of Environ. Studies
(NASA TM X-51282; X-51282) OTS: $5.60 ph, $1.79 mf

The external thermal environment of orbiting spacecraft consists of the radiant energy of the sun, solar radiation reflected by the earth (or by any other celestial body near the spacecraft), and radiation emitted directly by the earth. This report emphasizes the thermal interaction between that environment and the spacecraft that are placed in it. Described are (1) the characteristics of the external and internal radiant energy that contribute to the spacecraft energy balance; and (2) the properties of materials that govern the absorption and emission of energy by the spacecraft. Also described is the spacecraft thermal-design process; included is a discussion of the boundary conditions, formulations of the energy balance equations, computer solutions, and the design of several spacecraft. E.K.R.

N64-17688* Southern Research Inst., Birmingham, Ala.
THE THERMAL CONDUCTIVITY OF "M-31" COATING MATERIAL Final Report on Task 4
John M. Carroll et al 9 Sep. 1963 39 p
(NASA Contract NAS8-5196)
(NASA CR-56007) OTS: $3.60 ph, $1.37 mf

Experiments were conducted to determine the thermal conductivity in duplicate of an "M-31" coating material (silicone base with potassium titanate fibers) from 100° to 1500° F (38° to 816°C). The "M-31" material was found to be anisotropic, depending on the orientation of the heat flow, either parallel or perpendicular to the plane of the fibers. Thermal conductivity determinations were made with the "M-31" specimen material oriented in these two primary directions. The conductivity determinations were made, utilizing three different apparatus, in order to cover the entire temperature range. The results yielded comparable data between the three apparatus for the same orientation of fiber with heat flow. R.T.K.

N64-17723* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTIVENESS OF RADIATION SHIELDS FOR THERMAL CONTROL OF VEHICLES ON THE SUNLIT SIDE OF THE MOON
John C. Arvesen and Frank M. Hamaker Washington, NASA, Apr. 1964 50 p refs
(NASA TN D-2130) OTS: $1.50

Results of this study indicate that solar and lunar radiation shields can eliminate many of the thermal problems apparent with unshielded vehicles on the lunar surface. Solar shields may reduce the amount of incident solar radiation so greatly that the temperatures on the vehicle will become independent of the vehicle's surface properties. Lunar radiation shields may be used to isolate, effectively, the vehicle from radiation emitted from the lunar surface. With a combination of solar and lunar shields, the surface temperatures of a vehicle can be reduced to a desirable level. Author

N64-17740 Iowa State U. of Science and Tech., Ames Ames Lab.
PEAK HEAT FLUX IN NUCLEATE BOILING HEAT TRANSFER
Bernard P. Breen and George Burnet Jan. 1964 58 p refs
(Contract W-7405-ENG-82)
(IS-810) OTS: $1.50

The use of surface thermocouples in the measurement of boiling heat flux was investigated. Acetone was boiled from a steam-heated, polished, horizontal, stainless steel tube. Single-wire thermocouples (diameter equal to 0.010 in.) were spot welded at different positions on the tube. Measurements recorded in nucleate and transition boiling showed characteristic differences, which were analyzed and are reported. A point of strong discontinuity in the measured boiling surface temperature was evident when the thermocouple site went from nucleate into transition boiling. A method of promoting early transition boiling near the thermocouple site was developed. From the information contained in this thermocouple signal, the approach to peak heat flux could be predicted. Author

N64-17745* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL RADIATION TO A FLAT SURFACE ROTATING ABOUT AN ARBITRARY AXIS IN AN ELLIPTICAL EARTH ORBIT: APPLICATION TO SPIN-STABILIZED SATELLITES
Edward I. Powers Washington, NASA, Apr. 1964 25 p refs
(NASA TN D-2147) OTS: $0.75

The derivation of total thermal radiation incident upon a flat plate rotating about an arbitrary axis is presented. The functional relationships between position in an elliptical earth orbit and direct solar radiation, earth-reflected solar radiation (albedo), and earth-emitted radiation (earthshine) are included. The equations have been programed for the IBM 7090 digital computer, resulting in solutions that relate the incident radiation to spin axis orientation and orbital position. Several representative orbits for a typical geometrical configuration were analyzed and are presented as examples. Author

N64-17746* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FREE-FLIGHT INVESTIGATION OF MASS-TRANSFER COOLING ON A BLUNT CONE TO A MACH NUMBER OF 10.6
Thomas E. Walton, Jr. Washington, NASA, Apr. 1964 39 p refs
(NASA TN D-2197) OTS: $1.00

Mass-transfer cooling parameters are presented with large injection rates of nitrogen coolant in a laminar boundary layer for both a porous stagnation point and a nonporous conical afterbody of a blunted cone in free flight to a maximum Mach number of 10.6. A reasonable correlation of both the present porous stagnation results for large rates of mass injection and three-dimensional laminar stagnation theory for low and moderate rates of mass injection was obtained. A substantial reduction of the equilibrium wall temperature was achieved on the nonporous conical afterbody with mass injection at the stagnation point. There was no effect on the correlation of data due to Mach number and Reynolds number variation with time. The derivation of the effective heats of ablation from the present transpiration results provides an extension of theory to supercircular velocities. Author

N64-17749* National Aeronautics and Space Administration, Washington, D.C.
THEORETICAL STUDIES OF A RADIATION-BALANCE

Michael T. Surh and Melvin G. Whybra (Mich. U.) Apr. 1964 54 p refs
(NASA Contract NASr-54(03))
(NASA TN D-2246) OTS: $1.50

This study is made in three parts. The purpose of part I is to derive differential equations governing the thermoelectrodynamic processes within the radiation thermocouple and to become familiar with various phenomena that are of interest to the study of the radiation thermocouple and radiation balance. The purpose of part II is to derive differential equations describing the response of the radiation balance completely and to obtain the transient and steady-state solutions of the response characteristics of the radiation balance. Part III presents a study of the minimum detectable power of a radiation detector and computes optimum design dimensions based upon the analysis of the minimum detectable power. Finally, design features of two types of radiation balance are proposed. Author

N64-17765* Aeronca Mfg. Corp., Middletown, Ohio
HEAT SHIELD HONEYCOMB PANELS Summary Report, 29 Jan. 1963-29 Jan. 1964
Donald Y. Potter and George W. Somers 28 Jan. 1964 133 p refs
(NASA Contract NAS8-5221)
(NASA CR-53315; ER-764) OTS: $10.50 ph, $4.19 mf

The principal effort in this program was the stress, thermal, and design analysis of two S-1C heat shield panel designs that differed by virtue of the panel mounting system. Either panel design appears to satisfy the S-1C requirements, provided the M-31 insulation is retained on the panel by deformation of the honeycomb insulation reinforcement. Additional items investigated include: (1) application of beryllium sheet to S-1C heat shield panels; (2) deflection characteristics of M-31 insulation with deformed stainless-steel honeycomb reinforcement; (3) analysis of braze defects, braze quality standards, and repair methods; and (4) analysis of holes in heat shield panels and experimental measurements of stresses at hole boundaries. Author

N64-17771* National Aeronautics and Space Administration, Washington, D.C.
MEASUREMENT OF RADIATIVE HEAT TRANSFER WITH THIN-FILM RESISTANCE THERMOMETERS
Leonard Bogdan (Cornell Aeron. Lab.) Mar. 1964 46 p refs
(NASA Contract NAS8-823)
(NASA CR-27) OTS: $1.25

The use of a dual-element thin-film resistance thermometer for measuring simultaneously the convective and radiative components of heat-transfer rate is described. Resistance elements consist of thin, platinum-alloy films deposited on substrates of fused quartz. Calibration procedures for evaluating the spectral absorption of radiant energy in the wavelength range from 0.8 μ to 2.6 μ are described. A summary of the test data, applicable to ambient room temperature conditions, is given. Author

N64-17782 General Electric Co., King of Prussia, Pa. Space Sciences Lab.
AEROTHERMOCHEMICAL BEHAVIOR OF GRAPHITE AT ELEVATED TEMPERATURES
S.M. Scala and L.M. Gilbert Nov. 1963 31p refs
(Contract AF 04(647)-269; Contract AF 04(694)-222)
(R63SD89; AD-432594)

The results are presented of a unified theoretical treatment of the graphite ablation process (including heat- and mass-transfer correlation equations) over the entire range of pressures and surface temperatures of interest (i.e., from room temperature up to 10,000° F). Author

N64-17827* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
MEASUREMENT OF HEAT TRANSFER AND RECOVERY FACTOR OF A COMPRESSIBLE TURBULENT BOUNDARY LAYER ON A SHARP CONE WITH FOREIGN GAS INJECTION
C. C. Pappas and Arthur F. Okuno Washington, NASA, Apr. 1964 86 p refs
(NASA TN D-2230) OTS: $2.25

Local heat-transfer and recovery temperatures of the turbulent boundary layer with foreign-gas injection of helium, air, and Freon-12 (CCl_2F_2) were measured on a porous cone at cone Mach numbers 0.7, 3.67, and 4.35 and in a Reynolds number range of 1 to 5 million. The heat-transfer coefficients generally show a substantial decrease of up to 80 percent from the zero-injection value for all injection gases, and the relative effectiveness of the gases is in accord with theory. The recovery temperature (wall temperature for zero heat transfer to the wall) at M = 0.7, for helium injection, increases with injection to a value greater than the total stream temperature and then decreases with increased injection. At the two higher Mach numbers, for all the injection gases tested, the recovery temperature first decreases with injection, then increases to values that can be greater than the total temperature of the stream. For the highest injection rates at Mach number 4.35, the heat transferred to the wall can increase with increased injection. The heat-transfer coefficient ratios are in general agreement with the Rubesin theory heat-transfer predictions for Mach numbers from 0 to 4.35. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-16916* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVALUATION OF A GRAVITY-SIMULATION TECHNIQUE FOR STUDIES OF MAN'S SELF-LOCOMOTION IN LUNAR ENVIRONMENT
Donald E. Hewes and Amos A. Spady, Jr. Washington, NASA, Mar. 1964 36 p refs
(NASA TN D-2176) OTS: $1.00

A new type of gravity-simulation technique was developed, and some tests were made to evaluate the suitability of the technique by using a preliminary setup. The results of these tests indicated that the technique was useful and that man will be able to walk and run on the moon but will have difficulty in changing his position rapidly. In addition, he should be able to jump vertical distances from 12 to 14 feet when unencumbered with a spacesuit or equipment and should most likely not sustain injury in falls from these distances; he should have little difficulty in climbing stairs, ladders, and poles. A motion-picture film supplement is made available to illustrate some of the results of these tests. Author

N64-17157* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASURED TRANSFER FUNCTIONS OF PILOTS DURING TWO-AXIS TASKS WITH MOTION
Hugh P. Bergeron and James J. Adams Washington, NASA, Mar. 1964 42 p refs
(NASA TN D-2177) OTS: $1.00

Measurements of human transfer functions, made by matching an analog pilot to a human pilot, have been obtained in tests where the variables were the number of axes being controlled, and operation with and without cockpit angular motion corresponding to the indicated error. The analog pilot contained three gains that were automatically adjusted to match the pilot. The tests were made with a gimbal-mounted simulator in which the simulated dynamics represented an inertia system with linear damping and control $2/s(s + 1)$, where s is the Laplace transform. The results show that, although a pilot operates in a manner similar to a linear mechanism with constant gains when in a fixed-base, single-axis control loop, the addition of a second axis to his task causes him to operate with time-varying gains. The further addition of motion to the simulation greatly reduces the amount of time variation in the measured gains of the pilot. The tests show that the measuring method promises to be a very useful means for obtaining data on human characteristics. Author

N64-17267 Sandia Corp., Albuquerque, N. Mex.
A METHOD FOR PERFORMING A HUMAN-FACTORS RELIABILITY ANALYSIS
A. D. Swain Aug. 1963 53 p refs
(SCR-685) OTS: $1.50

A method for performing a human-factors reliability analysis of a man–machine system is described. The outcome of this type of analysis is a quantitative assessment of the estimated degradation of a man–machine system resulting from human errors. Author

N64-17508 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio Behavioral Sciences Lab.
CONTROL OF A DISCRETE STOCHASTIC PROCESS AS A FUNCTION OF THE COSTS FOR MAKING CORRECTIVE ACTIONS
John P. Hornseth, Walter J. Huebner, and William H. Pearson Dec. 1963 19 p refs
(AMRL-TDR-63-111; AD-432826) OTS: $0.50

This research examines man's ability to control a discrete stochastic process. The cost (C_1) for correcting the process before it exceeded an arbitrary tolerance limit served as the experimental variable. The cost (C_2) for correcting this process after it exceeded the tolerance limit was fixed. For low C_1 costs, the human controller achieved optimum control (i.e., minimized control cost) within four 100-cycle trials. For high C_1 costs, the human controller achieved a level of control equivalent to that of the optimum controller on the first 100-cycle trial. An additional requirement to serve as a statistical sensor was imposed in controlling the process under low C_1 cost conditions. The human controller's response to this requirement was appropriate. The implications of these results to the design of discrete stochastic process controllers are discussed. Author

N64-17509 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio Behavioral Sciences Lab.
EFFECT OF TRANSIENT WEIGHTLESSNESS ON BINOCULAR DEPTH PERCEPTION
Edwin H. Sasaki Dec. 1963 18 p refs
(AMRL-TDR-63-134; AD-432802) OTS: $0.75

To determine the effect of transient weightlessness on binocular depth perception, five subjects were tested under three levels of gravity—0 g, 1 g, and 2 g—produced by flying a JC-131B aircraft through appropriate maneuvers. A modified Howard–Dolman depth perception apparatus was installed in the aircraft. The experimenter set one of three rods forward or backward 1, 2, 3, 4, 5, or 6 cm from the other two rods. Each of the six distance intervals was randomly assigned to one rod position and direction of displacement. The subjects then reported for each trial whether the rods appeared to be equally distant or whether one appeared to be in front or back of the other two. Results indicated that binocular depth perception was not appreciably affected by the three different gravity conditions. Author

N64-17510 Aerospace Medical Div. Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, Ohio
THE EFFECTS OF CURVILINEAR AND DISCRETE TRANSFORMATIONS OF ERROR INFORMATION ON HUMAN TRACKING PERFORMANCE
Darwin P. Hunt Dec. 1963 17 p refs Work conducted by Dayton U. and Antioch Coll.
(Contract AF 33(616)-7863; Contract AF 33(657)-7362)
(AMRL-TDR-63-137; AD-432707) OTS: $0.50

The effects of discrete nonlinear transformations of tracking error information on the accuracy and efficiency with which the human operator can perform a compensatory tracking task were studied. Nine groups of seven subjects each were given forty 1-min trials under nine different informational display conditions. Indices of tracking accuracy and tracking efficiency were obtained by integrating absolute values of the voltage analogs of the actual tracking error and of the control stick deflections, respectively. Greater tracking accuracy was associated with (1) a linear relationship between displayed error and actual error, (2) a larger number of informational categories, and (3) practice. Generally, tracking accuracy improved in a negatively accelerated fashion as the number of informational display categoreis increased. Tracking efficiency generally increased with practice. Author

N64-17536 Joint Publications Research Service, Washington, D.C.
SELECTING SPACESHIP CREW BY PSYCHOLOGISTS
M. Novikov 25 Mar. 1964 7 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 9, Sep. 1963 p 39–41
(JPRS-23853; OTS-64-21885) OTS: $0.50

The two main psychological aspects of spaceflight are discussed. These are (1) the interactions of people engaged in group activity and (2) the effect of long residence in the closed system of a spaceship. The ways in which the psychological selection of crews can help to minimize these problems are discussed. R.T.K.

N64-17738 Joint Publications Research Service, Washington, D.C.
PHYSIOLOGICAL REACTIONS OF COSMONAUTS DURING THE ACTION OF G-LOADS AND WEIGHTLESSNESS
V. I. Yazdovskiy, I. I. Kas'yan, and V. I. Kopanev (USSR Acad. of Med. Sci.) 27 Mar. 1964 33 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), v. 29, no. 1, 1964 p 12–31
(JPRS-23917; OTS-64-21924) OTS: $1.00

The flights by Soviet and American cosmonauts showed the possibility of man's residence under conditions of weightlessness for a period of 120 hours. Monitoring systems of the health status and work capability of the cosmonauts made it possible to obtain valuable information on the nature of changes in the functional condition of the cardiovascular and respiratory systems in the course of flight. During the period of putting the ship into orbit, the pulse rate increased; during

the period of weightlessness, it gradually lowered. It was minimal during sleep and increased again during the descent of the spaceship. The time intervals of the EEG and the EKG during flight did not change substantially. The respiratory rate decreased in the period of acceleration and increased slightly during orbital flight. Author

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-16966 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
GIGANTIC RADIO EYE
T. Akkuratova 28 Mar. 1963 5 p Transl. into ENGLISH from Trud, 8 Dec. 1962, p 4
(FTD-TT-63-110/1; AD-402586)

A description is given of the diagonal radio telescope being built at Serpukhov. The east–west antenna of the telescope has a length of 1 km. The length of the antenna creates a high resolving power for the instrument. R.T.K.

N64-16972 Bendix Corp., Southfield, Mich. Research Labs. Div.
AUTOMATED ANALYTICAL STEREOPLOTTER DESIGN DATA AND ANALYSIS Technical Documentary Report [1 Jul.–31 Oct. 1963]
W. E. Chapelle Griffiss AFB, N.Y., Rome Air Develop. Center, Jan. 1964 109 p
(Contract AF 30(602)-2942)
(RADC-TDR-63-539; AD-432075)

A system design has been prepared and analysis has been performed for an automated version of the AS-11A analytical stereoplotter. The automated system uses electronic image-correlation equipment in conjunction with the AS-11A control computer to automatically produce contour and profile charts. Full AS-11A system capability for accommodating frame or panoramic photography, either vertical or convergent, is retained. The system is designed to contour and profile at rates up to 10 mm/sec with a 45° terrain-slope condition, considerably faster than the practical limit of 1 to 2 mm/sec for the manually operated standard system. Variable conditions of contrast and information content as encountered in typical aerial photography can be accommodated. Capability is provided for semiautomatic orientation of the stereo model, for operation as a standard AS-11A system, and for visual monitoring during automatic operation. Author

N64-16981 Army Missile Command, Huntsville, Ala. Inertial Guidance and Control Lab.
DESIGN STUDY FOR A HIGH G GYRO AS PART OF A RESEARCH FEASIBILITY STUDY ON NEW CONCEPTS IN HIGH G INERTIAL INSTRUMENTS
Aubrey Rodgers 15 Nov. 1963 48 p refs
(RG-TR-63-28; AD-431712)

This document presents the results of a research feasibility study of a gyro suitable for operation in a 100 to 200 g environment. It discusses the theory of operation, gives design equations, and presents a preliminary design for such a gyro. Author

N64-17007 Queen's U., Belfast (Northern Ireland)
ALL-SKY INTERFEROMETER FOR AIRGLOW STUDIES
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 22–23 ref (See N64-17002 09-23)

All-sky interferometer and narrowband filter techniques are under development for investigating the structure of the airglow. An improved interferometer, incorporating an f/1.0 Schmidt camera, is currently located at L'Observatoire de Haute Provence for field trials. Author

N64-17218 Naval Research Lab., Washington, D.C.
DIRECT-READING DERIVATIVE SPECTROMETER
D. L. Mitchell *In its* Rept. of NRL Progress, Nov., 1963 p 1–3 (See N64-17217 09-01) OTS: $1.25

A system has been developed that permits the direct measurement of wavelength derivatives of spectral curves. The system may be utilized to detect weak absorption lines in a manner analogous to the system employed in nuclear magnetic resonance spectroscopy. Author

N64-17291 California U., Livermore, Calif., Lawrence Radiation Lab.
A PRECISION FLYING SPOT FILM DIGITIZER
Jerome A. G. Russell 13 Dec. 1963 14 p refs
(Contract W-7405-ENG-48)
(UCRL-7619)

This device and its associated data handling system measure locations of images on transparent film by automatically scanning an area on the film with a mechanically generated flying spot of light. These location measurements are directly transmitted to a digital computer for subsequent processing. The digital computer controls and monitors the digitizing equipment operations. Initially, a film to be analyzed is placed manually into the digitizer. If a large volume of a film is to be processed, a computer-controlled automatic strip-film transport can be installed. A 4-in. × 5-in. negative can be scanned by a raster whose pitch is 50 μ in about 3 minutes. A field 4 in. wide may be digitized to ± 4 μ, about one part in 25,000. R.T.K.

N64-17456 ARO, Inc., Arnold Air Force Station, Tenn.
EQUATIONS AND TABLES FOR THERMOCOUPLES 32°F REFERENCE JUNCTION
W. E. Spengler and D. K. Graham Arnold Eng. Develop. Center, Mar. 1964 75 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-55; AD-432828)

National Bureau of Standards tables of electromotive-force versus temperature for thermocouples have been fitted to third-degree polynomials in parts. The resulting coefficients are presented for six types of thermocouples. Tables derived from the fitted equations are also presented. Author

N64-17530 Union Carbide Nuclear Co., Oak Ridge, Tenn.
INSTRUMENTATION FOR MEASURING FREEZING POINTS OF URANIUM HEXAFLUORIDE-HYDROGEN FLUORIDE SAMPLES
M. J. Bartkus 12 Mar. 1964 14 p ref
(Contract W-7405-ENG-26)
(K-1590) OTS: $0.50

Instrumentation to facilitate the semiautomatic measurement of the freezing points of samples of binary mixtures has

been developed and applied to the problem of determining the composition of uranium hexafluoride–hydrogen fluoride mixtures. Use of the instrumentation reduced the time required for analysis of uranium hexafluoride–hydrogen fluoride mixtures by a factor of five. The components used were commercially available or were alterations to commercially available devices. Variations of the described instrumentation could be applied to the general problem of measuring the percentage of soluble contaminants in a compound. Author

N64-17531 Chicago U., Ill.
A TECHNIQUE FOR PRECISE ANALYSIS OF SATELLITE PHOTOGRAPHS Research Paper 17
Tetsuya Fujita Apr. 1963 54 p refs
(Cwb-WBG Grant 6)

Both precise and approximate methods of analyzing a series of satellite photographs by a graphical technique are presented in this paper. The approximate method, which might result in an error up to a few tenths of a degree of the geocentric angle, is applied to any picture series including one or more frames with the apparent horizon. The existence of a landmark is not essential in performing the analysis. In case landmarks and several apparent horizons are available in the series, the precise method characterized by a possible error of less than 0.2 deg is applicable. These two methods permit analysis of practically all satellite pictures with an accuracy required for research purposes. It has been found that this technique, with minor modification, can be applied also to the precise analysis of radiation data obtained by the scanning radiometers of both TIROS and future NIMBUS meteorological satellites. Author

N64-17535 Weapons Research Establishment (Australia)
AN INVESTIGATION INTO THE EFFECT OF STELLAR MAGNITUDE ON THE STAR CALIBRATION OF ASTROTAR BALLISTIC CAMERAS
G. W. Mc Quistan Apr. 1963 17 p
(OID 33)

Errors are introduced in the calibration of ballistic cameras by the use of star images of widely varying exposures. These errors are demonstrated in data from trial and distortion calibration plates taken with the Wild Astrotar Ballistic Cameras. Methods of eliminating these errors are discussed. Author

N64-17543 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Inst. für Luftfahrzeugfuhrung
SUGGESTIONS FOR THE STANDARDIZATION OF TEST PROCEDURES FOR BAROMETRIC ALTIMETERS AND PRESSURE-HEAD SPEED INDICATORS [VORSCHLAGE ZUR VEREINHEITLICHUNG DER PRUFMETHODEN FUR BAROMETRISCHE HOHENMESSER UND STAUDRUCKFAHRTMESSER]
E. Nickel 1963 48 p refs In GERMAN

Barometric altimeter measurement (on the basis of the pertinent standard atmosphere) and velocity-head speed indications (on the basis of the current hydrodynamic and gas dynamic laws) are discussed. The use of a scale reference temperature, instrument adjustments, and calibration tests are suggested in order to improve the accuracy of altimeter recordings. Adjustments and calibration tests are suggested for improving indicator accuracy. The physical interrelations between the altimeter and the indicator are described. The following are mathematically treated: (1) the determination of the relationship between altitudes, in geometrical length units, and geopotential altitude concepts; (2) the determination of the pressures at geometrical altitudes and the respective densities, in altitude units, taking into account acceleration due to gravity; (3) the determination of the geometrical altitude from the pressure at that altitude; (4) the relationship between the velocity head in the subsonic and supersonic area, respectively, and the flight velocity; (5) the determination of the velocity of sound, in different units, at different temperatures and altitudes; (6) the calculation of a local acceleration due to gravity; (7) the determination of a standard pressure altitude for a topographically designated area, such as an airport. Also, various tables representing the ARDC standard atmosphere, and calculations pertinent to the mathematical treatments are presented. I.v.L.

N64-17582* Illinois U., Urbana Coordinated Science Lab.
THEORETICAL AND EXPERIMENTAL STUDIES OF THE UNDERLYING PROCESSES AND TECHNIQUES OF LOW PRESSURE MEASUREMENT Final Report
D. Alpert 31 Jan. 1964 21 p refs
(NASA Grant NsG-376)
(NASA CR-53198) OTS: $2.60 ph, $0.83 mf

The program in low-pressure measurement centered about two major activities—first, a program of laboratory research in the general area of problems and techniques of low-pressure measurement, and second, a survey of current activities in aeronomy, particularly those involved with experimental studies of the neutral density and composition of the upper atmosphere. Among the topics discussed are studies of anomalous effects in ionization gages, studies in new methods of pressure measurement, thin-film electron sources, and a survey of measurement of neutral and ion composition of the upper atmosphere. R.T.K.

N64-17599* University of Southern Calif., Los Angeles
AN APPARATUS FOR MEASURING THE REFLECTION, TRANSMISSION, AND PHOTOELECTRON YIELDS OF THIN METALLIC FILMS IN THE EXTREME VACUUM ULTRAVIOLET
Boyd Mac Naughton and G. L. Weissler 15 Feb. 1964 28 p refs
(NASA Grant NsG-178-61)
(NASA CR-53287) OTS: $2.60 ph, $1.04 mf

Lack of sufficient incident light intensity below 450A has limited investigations to the portion of the spectrum above this wavelength. This report describes the equipment that is presently being readied to extend these measurements to 50 A. The specific experiments for which the equipment has been designed are: reflection, transmission, and photoelectron yield measurements of thin films in the wavelength range between 600 and 50 A, and measurement of the efficiencies of various gratings over the same spectral region. Since light dispersed by the grazing incidence monochromator should be highly plane polarized, provision has been made to allow rotating the target in two mutually perpendicular planes so that effects of polarization can also be studied. Author

N64-17604* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPARATUS FOR THE INVESTIGATION OF THE BIRESISTANCE STATE OF MATERIALS
Stanley M. Neuder and Frank A. Jerozal (Consultants and Designers, Inc.) Nov. 1963 10 p
(NASA TM X-54576; X-633-63-223) OTS: $1.10 ph, $0.80 mf

A description is given of the experimental apparatus, including a variable-amplitude, variable-time pulse generator designed and assembled for the research and development of

materials exhibiting a dual resistant state when subjected to certain electrical conditioning. Author

N64-17652 Perkin-Elmer Corp., Norwalk, Conn.
RESEARCH IN AUTOMATIC BALLOON INSTRUMENTATION FOR SELENODETIC MAPPING PHOTOGRAPHY Final Report
R. A. Kelley 20 Feb. 1964 117 p refs
(Contract AF 19(628)-2396)
(AFCRL-64-201; AD-430942)

A study was conducted to determine the feasibility of an automatic balloonborne selenodetic plate camera for high-resolution photography of the moon. The areas of investigation include the optical system, system configuration, system stabilization, photographic materials, plate camera arrangement and operation, plate calibration, possibilities for improved resolution, and estimated system performance. Diagrammatic arrangements of the system are provided. Studies indicate that low-contrast lunar details having dimensions exceeding 1,000 ft can be recorded photographically by working at the f/20 focal plane of a 36-in.-telescopic optical system. The optical form will be similar to that employed in Stratoscope II. Study results indicate the desirability of incorporating ground-controlled acquisition and automatic tracking of the lunar surface. It is concluded that an automatic balloonborne selenodetic plate camera system is feasible. Author

N64-17686* Bendix Corp., Southfield, Mich. Research Labs. Div.
DESIGN, DEVELOPMENT AND PROTOTYPE FABRICATION OF AN AREA HYDROGEN DETECTOR Monthly Progress Report, 1 Oct. 1963-31 Oct. 1963
P. A. Michaels 14 Nov. 1963 17 p refs
(NASA Contract NAS8-5282)
(NASA CR-55954; Rept. 2473) OTS: $1.60 ph, $0.80 mf

Major effort was directed toward the completion of the breadboard hydrogen detector. All electronic circuit boards for the control assembly were constructed and tested as individual circuits. The sensor element temperature control circuitry design was modified to prevent an unwanted oscillation. Additional design changes were made in the sensor assembly, fan-drive inverter, fan-motor control, and power supply circuits to decrease the total power consumption and simplify the system construction. R.T.K.

N64-17697* Republic Aviation Corp., Farmingdale, N.Y.
SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY. VOLUME 3: METEOROLOGICAL SENSORS [Final Report]
17 Jun. 1963 187 p refs
(NASA Contract NAS5-3189)
(NASA CR-55930; RAC-1333; SSD-1027) OTS: $13.00 ph, $5.81 mf

The meteorological-sensor study in this volume sets forth the essential considerations and requirements for the cloud-cover and heat-budget sensory systems for the synchronous meteorological satellite. A model is developed from which estimates can be made of the radiation incident on the meteorological sensors for both cloud-cover imaging and heat-budget measurement. Cloud-imaging sensor requirements are considered. Comparative data are presented on various photosurfaces, photoemissive tubes, and photoconductive tubes, as well as hybrid and special types of tubes. Included among the topics discussed are heat-budget measurement and infrared cloud-cover sensors. R.T.K.

N64-17713 Joint Publications Research Service, Washington, D.C.
MEASURING THE PRESSURE OF HIGH-INTENSITY PULSE JETS BY THE TENSOMETER METHOD
V. P. Borodin et al 30 Mar. 1964 12 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 6, 1963 p 104–107
(JPRS-23920; OTS-64-21926) OTS: $0.50

A transducer is described for measuring dynamic pressures of the order of tens of thousands of atmospheres. The transducer is made in the form of a pitot tube with a cylindrical tensometer. The transducer is simple, reliable, and practically inertia-less. A jet stream was measured for dynamic pressure utilizing the tensometric method. A description is given of the dynamic pressure measurements by utilizing the transducer. By this method, successful high dynamic pressure measurements are possible. C.L.W.

N64-17720 Pratt and Whitney Aircraft, Middletown, Conn.
LCRE NEUTRON SENSOR DEVELOPMENT PROGRAM
R. C. Harrison 23 Mar. 1964 49 p refs
(Contract AT(30-1)-2789)
(PWAC-424) OTS: $1.25

A Reuter–Stokes high-temperature ion chamber and fission counter were operated at 400° F for 8,910 and 7,630 hr, respectively, without degradation. The test was designed to determine the long-term temperature effects and did not involve radiation damage. As part of the continuing program of reactor irradiation tests, four ion chambers and four fission counters with preamplifiers were irradiated at the Battelle Research Reactor for approximately 2,200 hr at 400° F. All units operated satisfactorily at the end of the test. The maximum radiation dose received by the sensors was 9.4×10^{16} nvt thermal, 5.9×10^{15} nvt fast (>1 Mev), and 3.6×10^{11} ergs/gm (C), which was in excess of the expected 10,000-hr LCRE dose by a factor of 10. Author

N64-17728* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECTS OF CESIUM VAPOR ON BAYARD-ALPERT IONIZATION GAGES AT PRESSURES LESS THAN 10^{-5} TORR
Robert L. Summers Washington, NASA, Mar. 1964 17 p refs
(NASA TN D-2264) OTS: $0.50

A study has been conducted to determine the effects of cesium vapor on ionization gages. Although no permanent damage to the gages was noted over a period of months, temporary gage failure due to cesium plating on the gage was noted after a few hours at cesium pressures above 10^{-6} torr. At pressures below 10^{-6} torr, the response of the gage to changes in cesium pressure was inhibited by the condensation of cesium on the envelope and tubulation. For stable pressure readings from the gage, periods of several hours were required. The ionization-gage sensitivity to cesium was 13.7 times the gage air sensitivity, with a probable error of 14 percent. Author

N64-17742 Union Carbide Nuclear Co., Oak Ridge, Tenn. Instrument Development Dept.
A FIXED FILTER PAPER ALPHA AIR MONITOR
G. B. Seaborn 23 Mar. 1964 18 p refs
(Contract W-7405-ENG-26)
(K-1589) OTS: $0.50

An instrument has been developed for the detection of uranium dust in the atmosphere. The principal feature of this

device is its ability to indicate a gross release of alpha radiation within a few minutes of its occurrence. The unit will sound an alarm when either the indicated level or the rate of increase exceeds present values above normal background variations. Author

N64-17744* National Aeronautics and Space Administration, Washington, D.C.
NONPOLARIZING ELECTRODES FOR DETECTING SLOWLY VARYING BIO-POTENTIALS IN INTERNAL CAVITIES [NEPOLYARIZUYUSHCHIYESYA ELEKTRODY DLYA VNUTRIPOLOSTNOGO OTVEDENIYA MEDLENNO IZMENYAYUSHCHIKHSYA BIOPOTENTSIALOV]
V. I. Bel'kevich, E. Yu. Vende, and I. A. Vil'-Vil'yams Apr. 1964 8 p Transl. into ENGLISH by John F. Holman and Co., Inc. from Fiziol. Zh. SSSR im. I. M. Sechenova (Moscow), v. 49, no. 3, 1963 p 379–381
(NASA TT F-199) OTS: $0.50

A nonpolarizing electrode for accurately measuring biopotentials in internal cavities is described. The electrodes have a stable and minimum electromotive force and, by virtue of a special protective layer, safeguard living tissue from the detrimental effects of the electrolytes. Author

N64-17754 Los Alamos Scientific Lab., N. Mex.
A NEW SOLUTION CALORIMETER
George C. Fitzgibbon, Daniel Pavone, Elmer J. Huber, Jr., and Charles E. Holley, Jr. 13 Mar. 1964 26 p refs
(Contract W-7405-ENG-36)
(LA-3031) OTS: $0.50

The design and operation of an isothermal solution calorimeter are described. A new feature is the continuous automatic recording of the calorimeter temperature. Author

N64-17815* Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF A BLOOD-PRESSURE TRANSDUCER Final Report
G. L. Pressman and P. M. Newgard Nov. 1962 35 p refs
(NASA Contract NAS2-809; SRI Proj. 4025)
(NASA CR-53362) OTS: $3.60 ph, $1.25 mf

An external, arterial-blood-pressure transducer was designed, built, and tested. This improved model provided a reasonable compromise between the small size that was desired and ease of construction. Tests showed satisfactory comparison between the reading of blood pressure from the transducer and the value given by a sphygmomanometer, thus verifying the design theory. Because of the relatively large size of the present transducer, it is most valuable for use on the radial artery. Author

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-16902 Joint Publications Research Service, Washington, D.C.
PRIMARY AND INITIAL PROCESSES OF THE BIOLOGICAL EFFECT OF RADIATION
G. M. Frank, ed. 27 Feb. 1964 129 p refs Transl. into ENGLISH of portions from "Pervichnyye i Nachal'nyye Protsessy Biologicheskogo Deystviya Radiatsii" Moscow, Publishing House of the Acad. of Sci. USSR, 1963 p 45–52, 157–191, 202–213, 234–242, and 271–276
(JPRS-23426; OTS-64-21670) OTS: $2.75

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2. THE MECHANISM SUPPRESSING CELL DIVISION UNDER THE INFLUENCE OF IONIZING RADIATION A. V. Lebedinskiy, V. M. Mastryukova, and A. D. Strzhizhovskiy p 15–31 refs (See N64-16904 09-16)
3. BIOCHEMICAL MECHANISMS OF RADIATION-INDUCED DISTURBANCE OF CELL DIVISION A. M. Kuzin p 32–53 refs (See N64-16905 09-16)
4. THE SIGNIFICANCE OF CELL DAMAGE IN THE RADIATION REACTION OF THE ANIMAL ORGANISM E. Ya. Grayevskiy, I. M. Shapiro, N. M. Konstantinova, and N. F. Barakina p 54–79 refs (See N64-16906 09-16)
5. THE RHYTHM OF OXIDATIVE PROCESSES AND ITS DISTURBANCE BY THE EFFECT OF RADIATION G. M. Frank and A. D. Snezhko p 80–100 refs (See N64-16907 09-16)
6. KINETIC REGULARITIES OF PRIMARY REACTIONS AND CHEMICAL PROTECTION B. N. Tarusov p 101–115 refs (See N64-16908 09-16)
7. CONCLUDING REMARKS G. M. Frank p 116–126 (See N64-16909 09-16)

N64-16903 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF RADIOCHEMICAL EFFECTS IN BIOLOGICAL OBJECTS BY THE ELECTRON PARAMAGNETIC RESONANCE METHOD
L. A. Blyumenfel'd and A. E. Kalmanson *In its* Primary and Initial Processes of the Biol. Effect of Radiation 27 Feb. 1964 p 1–14 refs (See N64-16902 19-16) OTS: $2.75

Amino acids, in the crystalline state, and protein tissues in the form of lyophically desiccated preparations, were investigated. Irradiation was conducted with a Co source, and the doses were of the order of 10^6 to 10^7 r. Results are: (1) Irradiated dry preparation of amino acids, as a rule, yield intense EPR spectra with a width of tens and hundreds of oersteds, and with sharply pronounced hyperfine structure resulting from the interaction of unpaired electrons with the protons and nuclei of nitrogen, which are a part of the free radicals formed. With a dose of the order of 10^7 r, the yield of free radicals amounts to about 10^{19} paramagnetic particles/g. It can be said that approximately one free radical is formed for each act of ionization. (2) Two peculiarities become obvious in the EPR spectra of irradiated native proteins and lyophilized tissues containing 60% to 80% protein. The number of free radicals emerging in the event of an equal dose of gamma irradiation in the proteins and in the tissues is less by 2 to 3 orders of magnitude than in amino acids and peptides. The signal does not represent the superimposition of the EPR spectra of individual amino acids and is usually a solitary narrow peak with a half-width of 2 to 6 gauss, and there is a complete lack of hyperfine structure. I.v.L.

N64-16904 Joint Publications Research Service, Washington, D.C.
THE MECHANISM SUPPRESSING CELL DIVISION UNDER THE INFLUENCE OF IONIZING RADIATION

A. V. Lebedinskiy, V. M. Mastryukova, and A. D. Strzhizhovskiy *In its* Primary and Initial Processes of the Biol. Effect of Radiation 27 Feb. 1964 p 15–31 refs (See N64-16902 09-16) OTS: $2.75

Statistical analysis is applied to the solution of the intracellular effects, synthesis, and elimination of metabolic products. This analysis is based on the determination of the possible changes of K, the rate of the cell-division process. It is assumed that there are only two causes for the inhibition of mitotic activity—blockage of the synthesis of the biochemical complexes necessary for mitotic activity, and blockage of the genetic mechanisms. A theoretical curve is given describing the mitotic index of an irradiated population as a function of time and of the irradiation dose. Mitotic activity, following irradiation, abates according to an exponent, the period of which equals the duration of mitosis. The initial value of the mitotic index is determined by the number of cells that escaped direct injury to the genetic apparatus in mitosis. The minimum value of mitotic activity is determined by the number of cells that escaped injury to both biochemical and genetic structures. The recovery rate is determined by $\alpha + K$, where α is the rate of cell recovery. The form of the recovery curve depends on the irradiation dose or on the degree of cell injury. Also, the effects of extracellular factors on cell division are discussed. I.v.L.

N64-16905 Joint Publications Research Service, Washington, D.C.

BIOCHEMICAL MECHANISMS OF RADIATION-INDUCED DISTURBANCE OF CELL DIVISION

A. M. Kuzin *In its* Primary and Initial Processes of the Biol. Effect of Radiation 27 Feb. 1964 p 32–53 refs (See N64-16902 09-16) OTS: $2.75

The biochemical mechanisms of the radiation-induced disturbance of cell division are reviewed. Neither tyrosine nor dialyzed melanins protect DNA from depolymerization, whereas low-molecular products of the enzymatic oxidation of tyrosine completely (under experimental conditions) protect DNA from the action of radiation. In addition, a certain specificity of this protection is indicated. It is believed that the causal sequence of events in an irradiated cell is as follows: The energy absorbed by the cytoplasm mitochondria is realized in insignificant physicochemical shifts in the state of the supramolecular structures of these organelles of the cell. There is a disturbance in the coordination of the action of the enzymes that are arranged in an orderly fashion in these organelles. There is an intensification of the activity of the phenol oxidases. The resulting surplus products of the enzymatic oxidation of tyrosine (or of the polyphenols similar to it), which are of a quinoid and semiquinoid structure with the properties of free radicals, diffuse toward the cell nucleus, where they form unstable addition products of DNA. The blocked DNA is unable to assure that the cells begin the mitotic process and results in a reduction of the mitotic index. I.v.L.

N64-16906 Joint Publications Research Service, Washington, D.C.

THE SIGNIFICANCE OF CELL DAMAGE IN THE RADIATION REACTION OF THE ANIMAL ORGANISM

E. Ya. Grayevskiy, I. M. Shapiro, N. M. Konstantinova, and N. F. Barakina *In its* Primary and Initial Processes of the Biol. Effect of Radiation 27 Feb. 1964 p 54–79 refs (See N64-16902 09-16) OTS: $2.75

Cellular changes underlie the radiation syndrome in mammals. Large-scale, early cell destruction occurs only in directly irradiated tissues. Cell death takes place only in cases where an injured substrate is functioning. It can be assumed that the specific function that effects radiation injury is the process of differentiation. The late death of cells remaining after massive disintegration is the consequence of chromosomal imbalance or of the inability of a cell to accomplish division as a result of gross structural changes in the chromosomes. The principal factor limiting regeneration of irradiated tissues, after exposure to doses of 700 to 3000 r, is the small number of viable cells, since most of them carry lethal chromosomal rearrangements. Direct determinations of the O_2 tension in tissues have shown that a number of factors (hypothermia, neurotropic substances, hemoglobin-combining substances, and dimercapto compounds) exerts a protective effect against radiation by lowering the O_2 tension in tissues. Certain protective agents (monothiols and thiourea derivatives) are very effective against radiation, but do not cause tissue hypoxia. I.v.L.

N64-16907 Joint Publications Research Service, Washington, D.C.

THE RHYTHM OF OXIDATIVE PROCESSES AND ITS DISTURBANCE BY THE EFFECT OF RADIATION

G. M. Frank and A. D. Snezhko *In its* Primary and Initial Processes of the Biol. Effect of Radiation 27 Feb. 1964 p 80–100 refs (See N64-16902 09-16) OTS: $2.75

The effect of radiation on rabbit brain tissue was among the experiments discussed concerning the effect of radiation on the oxygen balance of tissues. It was found that, concomitant with changes in the level of free oxygen in tissues after irradiation and with changes in the "oxygen assay" curve, disturbances of the rhythm in the oxygen content were also observed. The rhythm not only fluctuated but in many cases disappeared altogether within 8 to 10 minutes after termination of irradiation, in both the cortex and subcortex. Its recovery occurred in various ways. As a rule, speedier oscillations recovered in 30 minutes, whereas the depression of slow oscillations lasted for a protracted period. It was obvious that the radiation damaged some link of the rhythmical activity associated with the oxidative processes, with an extremely rapid manifestation of the effect. The recovery of the rhythmical activity did not coincide, in time, with the recovery of the oxygen-utilization capacity. Although both processes are to some extent interrelated, this interrelation is not rigid or single valued. I.v.L.

N64-16908 Joint Publications Research Service, Washington, D.C.

KINETIC REGULARITIES OF PRIMARY REACTIONS AND CHEMICAL PROTECTION

B. N. Tarusov *In its* Primary and Initial Processes of the Biol. Effect of Radiation 27 Feb. 1964 p 101–115 refs (See N64-16902 09-16) OTS: $2.75

Kinetic regularities of the primary reactions and chemical protection in radiation damage are reviewed. Protective agents are effective in activating the autolytic process. It was established that cysteine and β-mercaptoethylamine, when systematically injected, accelerate the development of radiation injury after internal and external irradiation of rats by radioactive substances (cesium, strontium). This acceleration was due to the chemicals' activating autolysis. There is reason to assume that the absence of protective action, and even the negative action of protective agents, takes place as a consequence of the activation of the autolytic process or its precursor. This can be regarded as a first approximation of an understanding of the kinetic regularities of primary reactions. I.v.L.

N64-16909 Joint Publications Research Service, Washington, D.C.

CONCLUDING REMARKS

G. M. Frank *In its* Primary and Initial Processes of the Biol. Effect of Radiation 27 Feb. 1964 p 116–125 (See N64-16902 09-16) OTS: $2.75

A discussion is presented of two lines of approach to a more rational analysis of the jumble of interrelationships that takes place in the experimental radiochemical, biochemical, and cytological (including cytochemistry) data of radiobiology. The first line of approach is a study of the circumstances that alter the character of the biological effect in the presence of radiation action, i.e., the most diverse additional condition such as the presence or absence of oxygen, temperature effects, various protective substances, etc. The comparison of the observed effects in biological experiments during exposure to radiation of a living system with those during exposure to radiation of model chemical systems must also be included, as well as a complete series of objects of gradually increasing complexity, from a molecule to a virus particle or a bacterial particle, and on to a plant or an animal cell. The second line of approach is the use of new methodological processes that permit the direct recording of primary processes. Included in this type of procedure is the method of electron paramagnetic resonance, which makes it possible to observe the emergence, as well as the character, of free radicals that appear as a result of irradiation. I.v.L.

N64-16927 European Atomic Energy Community, Brussels (Belgium)
ANATOMO-PHYSIOLOGICAL SCHEMA OF THE GASTRO-INTESTINAL TRACT, TO BE TAKEN IN ACCOUNT IN DETERMINING THE LEVELS OF RADIOACTIVE CONTAMINATION [SCHEMA ANATOMO-PHYSIOLOGIQUE DU TRACTUS GASTROINTESTINAL A PRENDRE EN CONSIDERATION POUR LE CALCUL DES NIVEAUX DE CONTAMINATION RADIOACTIVE]
Claudine Fabry (Centre d'Etudes Nucleaires de Fontenay-aux-Roses) 1963 27 p refs In FRENCH; ENGLISH summary
(Contract EURATOM 003-63-10 PSAF)
(EUR 489.f) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 50 Belg. Fr.

Anatomical and physiological data of the gastrointestinal tract of adults and children were summarized in a standard schema, to be used in calculating the levels of radioactive contamination in the food chain. Author

N64-16945 Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.
MEDICAL DIVISION RESEARCH REPORT FOR 1963
Gould A. Andrews et al [1963] 111 p refs
(Contract AT(40-1)-GEN-33)
(ORINS-43) OTS: $2.25

Activities in the following areas are reported: (1) studies of radiation effects, (2) lipid metabolism and radiation, (3) amino acid metabolism and irradiation, (4) immunology, (5) metals metabolism and medical radionuclides, (6) radioisotopes in diagnosis and therapy, (7) medical instruments development, and (8) scanning and whole body counting. R.T.K.

N64-16950 Joint Publications Research Service, Washington, D.C.
INTERRELATIONSHIP BETWEEN SUPER-FAINT CHEMILUMINESCENCE AND HEAT RESISTANCE OF PLANT ORGANISMS
R. A. Gasanov et al 18 Mar. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, v. 153, no. 4, 1963 p 947–949
(JPRS-23735; OTS-64-21820) OTS: $0.50

The effect of elevated temperatures on the biochemiluminescence and on the temperature maxima of biochemiluminescence of heat-resistant plants and nonheat-resistant plants and also on various wheat and barley varieties differing in heat resistance was examined. The results demonstrated that different species of the plants investigated have specific temperature maxima of biochemiluminescence. The varieties of the same species also have difinite temperature maxima of biochemiluminescence that can serve as an index of the heat resistance of the plant. Author

N64-17167 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HERALD OF THE ACADEMY OF MEDICAL SCIENCES OF THE USSR (SELECTED ARTICLES) [No. 5, 1962]
16 Apr. 1963 67 p Transl. into ENGLISH from Vestn. Akad. Med. Nauk SSSR (Moscow) p 24–38, 47–52, 64–68, and 93–101
(FTD-TT-62-1097/1+2; AD-402585)

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3. THE INFLUENCE OF CHEMOTHERAPEUTIC AGENTS ON THE PROTECTIVE FUNCTIONS OF THE ORGANISM Kh. Kh. Planel'yes p 29–39 (See N64-17170 09-16)

4. STIMULATION OF THE PROTECTIVE FUNCTIONS OF THE ORGANISM WITH PHYSICAL AGENTS A. N. Obrosov, F. D. Vasilenko, and Ye. B. Markovnikova p 40–49 (See N64-17171 09-16)

5. THE ROLE OF ANAEROBIC AND OXIDATIVE PHOSPHORYLATION PROCESSES IN THE PROTECTIVE FUNCTIONS OF THE ORGANISM S. Ye. Severin p 50–64 (See N64-17172 09-16)

N64-17168 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE ROLE OF THE HYPOPHYSEAL-ADRENAL SYSTEM IN IMMUNOLOGICAL AND INFECTION PROCESSES
V. I. Ioffe and L. P. Kopytovskaya *In its* Herald of the Acad. of Med. Sci. of the USSR (Selected Articles) [No. 5, 1962] 16 Apr. 1963 p 1–12 (See N64-17167 09-16)

Three topics are discussed: (1) the role of the hypophyseal-adrenal system in the development of an allergic reaction; (2) the influence of the hypophyseal-adrenal system on sensitivity to microbial poisons; and (3) the role of the hypophyseal-adrenal system in the development and course of infection processes. R.T.K.

N64-17169 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DISRUPTIONS OF NATURAL IMMUNITY IN IRRADIATED ANIMALS AND METHODS OF STIMULATING IT
V. L. Troitskiy *In its* Herald of the Acad. of Med. Sci. of the USSR (Selected Articles) [No. 5, 1962] 16 Apr. 1963 p 13–28 (See N64-17167 09-16)

Experimental results indicate the following: (1) The reestablishment of hematogenesis is an important factor in the stimulation of natural immunity, which is disrupted under the action of radiation on the organism. (2) Homologous transplants of bone marrow are a powerful stimulus to hematogenesis and to the

reestablishment of the disrupted natural immunity of irradiated animals. (3) For preventing secondary reactions in such animals, it is wise to use an immunological method based on recognition that the immunological method reaction in irradiated bone marrow chimeras proceeds in two directions, "host against transplant" and "transplant against host," and a method of inducing ectopic myelogenesis, which eliminates the problem of tissue incompatability. R.T.K.

N64-17170 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE INFLUENCE OF CHEMOTHERAPEUTIC AGENTS ON THE PROTECTIVE FUNCTIONS OF THE ORGANISM

Kh. Kh. Planel'yes *In its* Herald of the Acad. of Med. Sci. of the USSR (Selected Articles) [No. 5, 1962] 16 Apr. 1963 p 29–39 (See N64-17167 09-16)

The factors that participate in the genesis of superinfections, which develop during the antibiotic therapy of bacterial infections, are discussed. These factors lead to an increase in the susceptibility of the organism to infections whose causative agents may be only slightly pathogenic and may even be the saprophytes that are always present on the surfaces of the mucous linings of man or animals. The development of superinfection depends on: (1) disruption of the barrier function of the epithelial coats; (2) depression of the barrier function of the regional lymph nodes; and (3) activation of the functions of the adrenal cortex, which secretes a hormone having a "proinfection" effect. R.T.K.

N64-17171 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STIMULATION OF THE PROTECTIVE FUNCTIONS OF THE ORGANISM WITH PHYSICAL AGENTS

A. N. Obrosov, F. D. Vasilenko, and Ye. B. Markovnikova *In its* Herald of the Acad. of Med. Sci. of the USSR (Selected Articles) [No. 5, 1962] 16 Apr. 1963 p 40–49 (See N64-17167 09-16)

Experimental results are cited that demonstrate the intensification of adaptational and trophic processes that occur under the action of physical stimuli. Experimental data are also presented that indicate the mechanism by which physical stimuli exert their action. R.T.K.

N64-17172 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE ROLE OF ANAEROBIC AND OXIDATIVE PHOSPHORYLATION PROCESSES IN THE PROTECTIVE FUNCTIONS OF THE ORGANISM

S. Ye. Severin *In its* Herald of the Acad. of Med. Sci. of the USSR (Selected Articles) [No. 5, 1962] 16 Apr. 1963 p 50–64 (See N64-17167 09-16)

The object of this paper is to show that ATP (adenosine triphosphate) plays a multifaceted role in the various functions of the organism, and that this compound is formed in the cells under two conditions—anaerobic and oxidative. R.T.K.

N64-17235 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.

THE VISUAL PERCEPTION OF SPATIAL EXTENT

Walter C. Gogel Sep. 1963 13 p refs
(CARI-63-20)

An equation expressing the relation between perceived frontoparallel size and physical depth was developed and applied to frontoparallel size judgments, determined with four observers under two viewing conditions. Using the same equation and an expression of the size–distance invariance hypothesis, an additional equation was developed that related perceived and physical depth. The additional equation, when applied to judgments of perceived depth from the same observers under the same viewing conditions, produced results that were not in agreement with those expected from the size–distance invariance hypothesis. This is interpreted as evidence against the validity of the size–distance invariance hypothesis in its usual form. The results from the apparent depth judgments were applied to the problem of the nonveridicality of the perceptual bisection of depth intervals. Author

N64-17236 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.

THE EFFECTS OF A TRANQUILIZER ON BODY TEMPERATURE

E. Arnold Higgins, P. F. Iampietro, Thomas Adams, and D. D. Holmes Oct. 1963 7 p refs
(CARI-63-23)

Four young adult mongrel dogs were exposed, twice untranquilized, to each of three environmental temperatures: 4.4° C, 23.9° C, and 37.8° C and exposed, twice tranquilized, with 2.2 mg/kg propiopromazine hydrochloride. Rectal temperatures were monitored and recorded continuously during 2-hr exposures. Little difference was noted in rectal temperature response for tranquilized and untranquilized animals at 23.9° C exposure. Tranquilized animals showed a greater decline in internal temperature at an environmental temperature of 4.4° C than control and showed a rise in rectal temperature during heat exposure (37.8° C) while control animals showed a decline. These results indicate an impairment in both heat loss and heat conservation mechanisms in the tranquilized animals during thermal stress, but little, if any, alteration of temperature control at a nonstressful ambient temperature. Author

N64-17241 Los Alamos Scientific Lab., N. Mex.

AN EXAMINATION OF A MODEL OF A SEARCH BY THE SENSE OF "SMELL"

M. H. Goldhaber 19 Feb. 1964 26 p
(Contract W-7405-ENG-36)
(LAMS-3027) OTS: $0.50

A scalar field is given in space. It is interpreted as an intensity of a quantity like "smell," e. g., density of some molecules—in the simplest case, emanating from a (stationary or moving) point source. An object (a macromolecule or an insect) tries to locate the source (another molecule in a cell or a source of food). The object is moving, and its inertia of motion or flight makes it impractical to determine in each point the steepest descent and to follow the gradient. The economical or practical strategy of a search is examined. Some elementary results are obtained for a two-dimensional version of the problem. Author

N64-17242 Joint Publications Research Service, Washington, D.C.

ESSAYS ON CYBERNETICS

Lev Pavlovich Teplov 6 Mar. 1964 482 p refs Transl. into ENGLISH of the book "Ocherki o Kibernetike" Moscow, "Moskovskiy rabochiy" Publishing House, 1963 415 p
(JPRS-23554; OTS-64-21728) OTS: $6.00

The topics discussed include the following: (1) cybernetics—its place in life and among sciences; (2) improbability—the mathematical measure of labor and knowledge; (3) the anatomy of thinking and an interplanetary robot; (4) automated machines; (5) feedback—the basis of automatism in nature and technology; (6) information and cybernetics; (7) information accumulation; (8) information control; (9) behavior; (10) signal converters; (11) logical machines; (12) automatic computing; (13) the

statistical machine; (14) the brain—a statistical system of living ion elements; (15) the complete automation; and (16) cybernetics and humanity. R.T.K.

N64-17244 Joint Publications Research Service, Washington, D.C.
CYBERNETICS IN BIOLOGY, MEDICINE, AND SPACE
A. Smirnov et al 19 Mar. 1964 46 p Transl. into ENGLISH of 8 articles from Russian periodicals
(JPRS-23749; OTS-64-21829) OTS: $1.25

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5. THE COSMOS AND CYBERNETICS Andrey Prokhorov and Il'ya Zakharov p 29–31
6. CYBERNETICS AND BIOLOGY V. G. Kocherezhkin p 32–37
7. CYBERNETICS AND SPACE FLIGHT Viktor Bukhanov p 38–40
8. RELIABILITY OF COSMIC FLIGHT A. G. Ivankhnenko p 41–43

N64-17252 Federal Aviation Agency, Oklahoma City, Okla. Civil Aeromedical Research Inst.
CENTRAL NERVOUS SYSTEM EFFECTS OF CHRONIC EXPOSURE TO ORGANOPHOSPHATE INSECTICIDES
J. Robert Dille and Paul W. Smith Oct. 1963 10 p refs
(CARI-63-24)

Two cases are reported in which persistent CNS changes were noted in aerial applicator pilots after chronic exposure to organophosphate insecticides. The symptomatology, the basis for these symptoms and EEG changes, and their reversibility are discussed. Author

N64-17312 Minnesota U., Minneapolis
THORACIC CAGE IMPEDANCE MEASUREMENTS. DYNAMIC CHARACTERISTICS OF AN IMPEDANCE PNEUMOGRAPH
Edwin Kinnen, William Kubicek, and G. Turton Brooks AFB, Tex., School of Aerospace Med., Dec. 1963 9 p refs
(Contract AF 41(657)-403)
(SAM-TDR-63-100; AD-430623)

An accurate calibration of an impedance pneumograph is complicated by two factors—tissue movement throughout the thorax during respiration and the mode of inspiration. In either case, the result is a variation in transthoracic electrical impedance that is not related to inspired air volume. It was found that the change of thoracic impedance as a function of inspired air volume for normal repeated inspirations had a variation of 50% at the 0.2-l level of inspiration, decreasing to 10% at the 2-l level. A significantly greater percent variation was noted for changes in the mode of subjects' breathing and between subjects. Author

N64-17351 Joint Publications Research Service, Washington, D.C.
STUDIES ON HIGHER NERVOUS ACTIVITY AND CONDITIONED REFLEXES
24 Mar. 1964 42 p refs Transl. into ENGLISH of 3 articles from Zh. Vysshei Nervnoi Deyatel'nosti im. I. P. Pavlova (Moscow), v. 13, no. 6, 1963 p 953–961, 1039–1045, and 1077–1086
(JPRS-23833; OTS-64-21874) OTS: $1.25

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1. CHANGE IN HIGHER NERVOUS ACTIVITY AND SOME VEGETATIVE REACTIONS DURING PROLONGED EXPOSURE TO CONDITIONS OF RELATIVE ADYNAMIA AND ISOLATION N. A. Agadzhanyan, Yu. P. Bizin, G. P. Doronin, and A. G. Kuznetsov p 1–15 refs
2. CONDITIONED INHIBITION IN DOGS WITH A UNILATERALLY REMOVED THALAMUS L. N. Gavrilova p 16–25 refs
3. CHANGES IN MOTOR CONDITIONED FOOD REFLEXES IN PIGEONS FOLLOWING A LESION OF THE PALEOCORTEX N. L. Krushinskaya (Moscow U.) p 26–39 refs

N64-17466 Rochester U., N.Y.
A FEASIBILITY STUDY OF A NEW DEVICE TO MEASURE RADON IN THE BREATH
John B. Hursh 13 Mar. 1964 23 p refs
(Contract W-7401-ENG-49)
(UR-640)

A new device developed for measurement of thoron in the breath has been studied for its suitability to detect breath radon. Calibration curves are presented, which show that the counting rate versus time for a given radon concentration is a function of gas flow rate. If the flow rate is held constant, the counting rate is directly proportional to radon concentration at any given time after gas flow begins. If 1 pc/L radon in air at standard conditions is passed through the detector at a rate of 7 L/min, the 20-minute total net count is 570 counts, which may be compared with a 20-minute background count of 4 counts. It is concluded that the proposed system should be satisfactory to detect radium burdens in man with a lower limit of about 0.01 μc. Author

N64-17491 Electronic Associates, Inc., Princeton, N.J. Education and Training Group
BIBLIOGRAPHY OF BIO-ENGINEERING MODELS AND MODEL MATCHING METHODS FOR ANALOG AND HYBRID COMPUTERS
A. Ben Clymer 17 Jun. 1963 8 p 132 refs

This bibliography includes the following topics: (1) human operator and general model-matching methods; (2) homeostatic systems; (3) biochemical kinetic and compartmental systems; and (4) neural systems. R.T.K.

N64-17498* Walter Reed Army Inst. of Research, Washington, D.C.
CONTINUOUS OPPORTUNITY FOR REINFORCING BRAIN STIMULATION
Elliot S. Valenstein and Bernard Beer Repr. from J. Exptl. Analysis of Behavior, v. 7, no. 2, Mar. 1964 p 183–184 refs
(NASA Grant NsG-437)

The performance of a rat that was provided with continuous opportunity to obtain reinforcing brain stimulation over a 20-day period is described in detail. The animal averaged 29.2 responses per minute during the entire time. The testing session was terminated by experimenters, but a day-by-day analysis of behavior provided no evidence that the animal would have stopped responding. Author

N64-17539 Czechoslovak Academy of Sciences, Prague
ELECTRIC PROPERTIES OF TISSUES [ELEKTRICKE VLASTNOSTI TKANI]
Jan Kryspin, Zdenka Harantova, and Bozena Safrankova 1963 52 p refs In CZECH; ENGLISH summary
(*Its* Rozpravy v. 73, no. 10)

Described is the methodical approach used for the measurement of electric properties of tissues, centered mainly on the ohmic component of impedance; for clinical research a commercially available apparatus, Foreometer PREMA, has been used. The principle of the method is the measurement of the potential difference of tissue, either spontaneous or caused by the constant current of known intensity flowing through the tissue. The experimental approach consists in ascertaining the function voltage–time ($E = f(t)$), or voltage–current ($E = f(I)$). The importance of the geometry of the system and of the nonpolarizability of electrodes in these measurements is emphasized. In several cases, a four-electrode measurement was carried out. Given are the results of research on the electric properties of human skin, of human squamous epithelium of the cervix uteri, of the aortic wall in rabbits and of liver, kidney, and brain tissue in mice and rats. Author

N64-17550 Deutsche Versuchsanstalt für Luft-und Raumfahrt, Bad Godesberg (W. Germany) Inst. für Flugmedizin
HAZARDS OF MANNED SPACE FLIGHT THROUGH SUDDEN PRESSURE LOWERING [GEFAHREN DER BEMANNTEN WELTRAUMFAHRT DURCH PLOTZLICHE DRUCKERNIEDRIGUNG]
H. Hartmann [1963] 9 p Presented at the Ann. Meeting of the Wiss. Ges. für Luft-und Raumfahrt, Munich, 8–12 Oct. 1963 In GERMAN

Hazards of manned spaceflight are reviewed from the standpoints of technical failure or micrometeorite impact, which result in a pressure drop in the space capsule along with a simultaneous disturbance in the pressure suit. It appears that in a sudden pressure drop the initial danger is air embolism. The solubility components take effect a few minutes later. However, air embolism is less hazardous than the effect of the solubility components, since the astronaut breathes only oxygen. Solubility components are discussed, along with the possibility of saving an afflicted astronaut in a large space vehicle, such as a space station. I.v.L.

N64-17555 Joint Publications Research Service, Washington, D.C.
ANTIRADIATION PROPERTIES OF GALLATES
A. A. Gorodetskiy and V. A. Baraboy 24 Mar. 1964 66 p refs Transl. into ENGLISH of chapters 1, 3, and 4 and the conclusion from the book "Protivoluchevyye Svoystva Gallatov" Kiev, 1963 p 5–12, 41–86, and 125–126
(JPRS-23834; OTS-64-21875) OTS: $1.75

The topics dicusssed are: (1) mechanisms of protection against radiation; (2) protective action of gallates during experimental acute radiation sickness; and (3) therapeutic action of gallates. The results of studies of the antiradiation, toxicological, and pharmacological properties of the gallates are summarized. R.T.K.

N64-17601* American Inst. of Biological Sciences, Washington, D.C.
AMERICAN INSTITUTE OF BIOLOGICAL SCIENCES INTERDISCIPLINARY CONFERENCE PROGRAM
Murray D. Rosenberg (Rockefeller Inst.) [1964] 4 p 2nd Conf. on Cellular Dyn. held at Princeton, N.J., 9–12 Feb. 1964
(NASA Contract NASr-132)
(NASA CR-53290) OTS: $1.10 ph, $0.80 mf

Discussions carried on during the conference were concerned with the following topics: the physical chemistry of interfaces; the structure of membranes; interactions between cell surfaces and solid substrata; cell–cell interactions; surface active enzymatic reactions; and localization of antigens at surfaces. P.V.E.

N64-17649 Frankford Arsenal, Philadelphia, Pa.
IMPROVEMENT OF LAP BELT TIGHTENER
F. T. Pisano Feb. 1964 20 p
(FA-M64-23-1; AD-432687)

Analytical and design studies were conducted on the aircraft lap-belt-tightener mechanism. Substitution of a ball-type initial lock mechanism for the Belleville spring increased the lap-belt-tightener tension load capacity, and use of a high-strength material increased the loop load capacity. A minor configuration change in the piston locking mechanism provided more reliable operation. In the final ballistic tests, the M67 cartridges were substituted for the M73. The M67 cartridge generated the desired gas pressure in the system and operated the lap-belt-tightener within the specified limits. Author

N64-17659 Naval Air Engineering Center, Philadelphia, Pa. Aerospace Crew Equipment Lab.
DETERMINATION OF RESPIRATORY REQUIREMENTS FOR GAS MIXTURES IN MANNED SPACE CAPSULES
Edwin Hendler 12 Mar. 1964 11 p refs
(NAEC-ACEL-518; AD-432462)

Requirements for artificial atmospheres in manned space vehicles are expressed in graphic form, and take into account varying proportions of oxygen and nitrogen in the respired gaseous mixture, as well as initial pressure (before decompression) and final pressure (after decompression). Criteria used in the determination of artificial atmosphere requirements include avoidance of both hypoxia and decompression sickness due to pressure changes. Author

N64-17707 California U., Berkeley. Lawrence Radiation Lab.
TRYPTOPHAN SYNTHETASE MUTANTS OF YEAST: ACTION OF A SUPER-SUPPRESSOR IN RELATION TO ALLELIC MAPPING AND COMPLEMENTATION
Thomas R. Manney (Ph.D. Thesis) 8 Jan. 1964 128 p refs
(Contract W-7405-ENG-48)
(UCRL-11191) OTS: $2.50

In order to construct an allelic map of the tryptophan synthetase locus (tr_5) a new method is developed. This method is based on the use of X-rays to induce allelic recombination at mitosis in heteroallelic diploids. The map is constructed from the slopes of X-ray dose-frequency curves. Of 32 tr_5 mutants, 13 are suppressed to prototrophy by a single super-suppressor, S_d. One other is changed to a different mutant phenotype by the same suppressor. These suppressible mutants map along the entire length of the X-ray allelic map, with four of them being repeat mutations at a site near one end of the map. There is a strong exclusion between complementation and suppressibility. Only 2 of the 13 suppressible alleles gave any evidence of allelic complementation, whereas all but five of the nonsuppressible ones complemented with at least one other. Author

N64-17766* Columbia U., N.Y. Biomedical Engineering Lab.
METHODS FOR DETERMINING BLOOD FLOW THROUGH INTACT VESSELS OF EXPERIMENTAL ANIMALS UNDER CONDITIONS OF GRAVITATIONAL STRESS AND IN EXTRA-TERRESTRIAL SPACE CAPSULES [Progress Report] 1 Aug. 1962-31 Jul. 1963

Robert Feldstein, James M. Kennedy, Louis B. Lambert, Albert F. Sciorra, and Robert F. Shaw 1 Aug. 1963 137 p refs
(NASA Grant NsG-112-61)
(NASA CR-53302; CU-3-63-NASA-112-ERL; Status Report P-3/168) OTS: $10.50 ph, $4.31 mf

A 30- to 90-day orbital study of the effects of sustained space flight upon physiologic performance has been designed utilizing experimental animals (primates) as the subjects. The study emphasizes complete assessment of the performance of the cardiovascular and respiratory systems. Three techniques are utilized: continuous measurement and telemetry of physiologic performance of critical organ systems; an inflight sensory-motor study making use of an operant conditioning schedule; and a complete inflight metabolic-balance study and preflight–postflight organ function tests. Systems analysis of alternative orbital systems has been performed, and weight, power, and similar requirements are presented for recoverable vs nonrecoverable systems, battery power vs solar power, for Rhesus monkeys and chimpanzees of various numbers, and for missions of various durations. Author

N64-17790* Martin Co., Denver, Colo.
RESCUE AND ESCAPE SYSTEMS FROM TALL STRUCTURES (RESTS) Final report
D. Lorenz, W. Offik, L. Blish, G. Batiuk, R. Sexton et al Oct. 1963 320 p refs
(NASA Contract NAS10-522)
(NASA CR-53344; NASA-CR-63-109) OTS: $19.75 ph, $9.80 mf

Comprehensive data are provided under the three major subdivisions of the study: hazards analysis, human factors, and concept development. The recommended escape system (a combination of several devices and techniques) is carefully documented with illustrations and testing data. Appendixes are provided on propellants, characteristics of explosion-generated shock waves, and general data. Author

N64-17805 Joint Publications Research Service, Washington, D.C.
THE MUTAGENIC AND ANTIMUTAGENIC ACTION OF SODIUM GALLATE
V. A. Baraboy and G. S. Yukova 20 Mar. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 5, 1963 p 1193–1194
(JPRS-23787; OTS-64-21849) OTS: $0.50

Experiments were carried out on germinating seeds of Russian black horse beans (*Vicia faba*) that were exposed to the action of different concentrations of sodium gallate solutions, prior to fixation. In sodium gallate concentrations of 0.00001 γ/ml (parts per ml) and 0.0001 γ/ml, an antimutagenic effect was detected. In the former concentration, the effect was completely reliable statistically; in the latter concentration, it is possible to speak only of a tendency toward a decreased percentage of natural mutations. Sodium gallate in higher concentrations (up to 1.0 γ/ml) displays a moderately marked mutagenic action, and only in a concentration of 100 γ/ml does this effect prove to be maximal, exceeding twice the control level. An analysis was made of the nature and amount of cellular damage (formation of bridges and fragments of chromosomes). I.v.L.

N64-17806 Joint Publications Research Service, Washington, D.C.
TWO FUSION THRESHOLDS OF LIGHT STIMULI IN THE VISUAL ANALYZOR OF MAN
M. I. Venslauskas and A. M. Gutman 31 Mar. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 153, no. 5, 1963 p 1202–1203
(JPRS-23946; OTS-64-21943) OTS: $0.50

A multineuronal system is stimulated when $\sigma = \epsilon - i \geq \sigma_0$ where σ is effective stimulation, and σ_0 is its threshold value. For a difference in the two stimuli, it is necessary and sufficient that the threshold σ_0 be reached during the first stimulus, that between the first and second stimuli, σ be less than the threshold, and that the threshold be reached during the second stimulus. Experimental data obtained with five subjects are presented in a table, and show the distribution of frequency of distinction of double stimuli. E.W.

N64-17838* National Aeronautics and Space Adminstration, Washington, D.C.
THE MEASUREMENT OF BLOOD PRESSURE IN THE HUMAN BODY
C. R. Smith and W. H. Bickley (Clyde Williams and Co.) Apr. 1964 39 p refs
(NASA SP-5006) GPO: $0.30

The importance of blood-pressure measurement is discussed in terms of the detection of malfunctions of the heart and diseases of the blood-carrying ducts. First, an explanation is given of what, exactly, is meant by blood pressure, followed by a discussion of the history of blood-pressure measurement. Blood-pressure measurements used in the 20th century are then described, and an outline is given of NASA's role in blood-pressure monitoring research. Finally, a discussion is given in support of the development of unconventional techniques in measuring blood pressure. C.L.W.

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-16958 Universal-Cyclops Steel Corp., Bridgeville, Pa. Refractomet Div.
WELDING OF REFRACTORY METALS Interim Report No. 5, 1 Oct.-31 Dec. 1963
D. J. Seman and F. D. Seaman Feb. 1964 23 p refs
(Contract NOw-63-0043-c)
(AD-431672)

Data given show the effect of InFab atmosphere on bend transition temperature and weld chemistry. Parameters for the multipass welding schedules are presented. Author

N64-16980 Shell Development Co., Emeryville, Calif.
BEARING LUBRICATION UNDER SEVERE CONDITIONS Bimonthly Progress Report, Dec. 1963–Jan. 1964
29 Feb. 1964 20 p
(Contract NOw-63-0466-c)
(S-13910; AD-431873)

The possibility of obtaining bearing failure (high bearing deposits) by prolonged bearing operation with an increased oil sump charge was investigated. Failure by loss of lubricant was obtained as in all previous tests with various lubricants. Increasing the lubricant charge increased the total operating time

from 36 1/2 hours (148 passes) to 114 1/4 hours (224 passes), but there was practically no difference in the operation of the bearing. For a system that fails by loss of lubricant, two equations are derived that relate initial lubricant charge, termination lubricant charge, lubricant recovery rate, and lubricant flow rate with total operating time and number of lubricant passes. The experimental values of time and number of passes for the current tests are in excellent agreement with values predicted by the derived expressions. A heated dual-tank reservoir to investigate the effect of operating with a high bulk oil temperature was built and is presently in operation. Author

N64-17021 Joint Publications Research Service, Washington, D.C.
SOVIET SHEET ROLLING TECHNOLOGY
10 Mar. 1964 17 p refs Transl. from RUSSIAN into ENGLISH (JPRS-23596; OTS-64-21752) OTS: $0.50

CONTENTS:

1. ROLLING COBALT POWDER INTO STRIP Yu. N. Semenov, G. S. Shmakov, and T. N. Berdyayeva p 1–6 refs (See N64-17022 09-17)

2. ROLLING HIGHLY-POROUS STRIP FOR FILTERS OF TITANIUM POWDER G. F. Tikhonov, U. K. Sorokin, and V. G. Khromov p 7–10 (See N64-17023 09-17)

3. ANALYSIS OF GASES IN MOLYBDENUM SHEET Ya. A. Klyachko, T. A. Izmanova, and Ye. M. Chistyakova p 11–14 (See N64-17024 09-07)

N64-17022 Joint Publications Research Service, Washington, D.C.
ROLLING COBALT POWDER INTO STRIP
Yu. N. Semenov, G. S. Shmakov, and T. N. Berdyayeva *In its* Soviet Sheet Rolling Technol. 10 Mar. 1964 p 1–6 refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 222, 1963 p 68–70 (See N64-17021 09-17) OTS: $0.50

Electrolytic cobalt powder was used for rolling into strip, and various tests were conducted on the samples thus produced. It was concluded that cobalt strip obtained from powder has the same mechanical properties as a strip produced from cobalt ingot. E.W.

N64-17023 Joint Publications Research Service, Washington, D.C.
ROLLING HIGHLY-POROUS STRIP FOR FILTERS OF TITANIUM POWDER
G. F. Tikhonov, U. K. Sorokin, and V. G. Khromov *In its* Soviet Sheet Rolling Technol. 10 Mar. 1964 p 7–10 Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 222, 1963 p 71–72 (See N64-17021 09-17) OTS: $0.50

Information is presented on the following: (1) the relation between porosity and thickness of titanium strip when rolling with a regulating device; (2) the dependence of the speed of filtration of diesel fuel and the strength of the strip on its porosity; (3) the dependence of the thickness and porosity of the strip and the speed of filtration of a liquid on the filling weight of titanium powder; and (4) the effect of dispersion of titanium powder on the porosity characteristics of the strip. R.T.K.

N64-17076 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE WORKING OF HEAT-RESISTANT ALLOYS [OBRABOTKA ZHAROPROCHNYKH SPLAVOV]
V. I. Dikushin, ed. 26 Nov. 1963 401 p refs Transl. into ENGLISH of 30 papers which were presented at the Conf. on Working of Heat Resistant Alloys, Machine Construct. Inst., Acad. of Sci., Moscow, 18–21 Dec. 1957 Moscow, Izd. AN SSSR, 1960 p 1–231
(FTD-TT-63-344/1+2; AD-430703)

CONTENTS:

1. MODERN HEAT-RESISTANT ALLOYS I. I. Kornilov p 6–20 (See N64-17077 09-17)

2. ALUMINIZING HEAT-RESISTANT, HIGH-TEMPERATURE CORROSION-RESISTANT AND THERMAL-SHOCK-RESISTANT TYPE YalT, EI435, EI589, AND EI415 MATERIALS FOR PURPOSES OF INCREASING THEIR HIGH-TEMPERATURE CORROSION RESISTANCE A. S. Stroyev and Ye. L. Zarubina p 21–31 a refs (See N64-17078 09-17)

3. CERTAIN CHARACTERISTIC PROPERTIES OF NICKEL-ALLOY SMELTING K. Ya. Shpunt p 32–38 (See N64-17079 09-17)

4. CAST GAS-TURBINE ROTOR BLADES F. V. Aksenov p 39–52a refs (See N64-17080 09-17)

5. THERMOMECHANICAL PROCEDURE OF PRESSURE WORKING HIGH-MELTING HEAT-RESISTANT ALLOYS BASED ON MOLYBDENUM AND CHROMIUM N. I. Korneyev, I. G. Skugarev, S. B. Pevzner, and Ye. I. Razuvayev p 53–66 refs (See N64-17081 09-17)

6. INFLUENCE EXERTED BY WORK HARDENING ON THE ENDURANCE OF HEAT-RESISTANT AND THERMAL-SHOCK-RESISTANT STEELS AT HIGH TEMPERATURES I. V. Kudryavtsev and B. I. Aleksandrov p 67–86c refs (See N64-17082 09-17)

7. STAMPING-COLD DRAWING OF COMPONENTS FORMED FROM HEAT-RESISTANT SHEET METALS WITH THE USE OF DEEP FREEZING V. N. Revinov p 87–95a refs (See N64-17083 09-17)

8. TECHNOLOGICAL PLASTICITY AND MECHANICAL PROPERTIES OF TITANIUM ALLOYS AS FUNCTIONS OF HOT DEFORMATION CONDITIONS V. Ya. Kleymenov and T. N. Sazonova p 96–106 (See N64-17084 09-18)

9. CHARACTERISTIC FEATURES OF THE TECHNIQUE OF SHEET STAMPING HEAT-RESISTANT AND TITANIUM ALLOYS Yu. P. Davydov p 107–119 (See N64-17085 09-17)

10. HEADING OF FASTENING STANDARDS FORMED FROM HEAT-RESISTANT STEELS I. S. Petrov p 120–127 (See N64-17086 09-17)

11. PRODUCING STEEL-BLADE PRECISION STAMPINGS BY THE METHOD OF HOT DEFORMATION M. Ya. Kuleshov p 128–141 (See N64-17087 09-17)

12. TECHNIQUE OF FABRICATING TURBINE-BLADE BLANKS FROM HEAT-RESISTANT ALLOYS WITH MINIMUM ALLOWANCE FOR THE SCOOP Ye. M. Eyfir p 142–159a refs (See N64-17088 09-17)

13. CHARACTERISTIC FEATURES OF HOT STAMPING TITANIUM ALLOYS L. A. Nikol'skiy p 160–177a ref (See N64-17089 09-18)

14. WELDING TURBINE COMPONENTS FORMED FROM HEAT-RESISTANT ALLOYS G. A. Nikolayev p 178–185a refs (See N64-17090 09-17)

15. AUTOMATIC ARC AND MOLTEN-SLAG ARCLESS ELECTRIC WELDING OF HEAT-RESISTANT ALLOYS B. I. Medovar p 186–202 refs (See N64-17091 09-17)

16. INERT-GAS SHIELDED ARC WELDING OF HEAT-RESISTANT ALLOYS Ye. M. Pronina p 203–212a refs (See N64-17092 09-17)

17. WELDING OF MARTENSITIC STEEL G. A. Nikolayev and A. V. Mordvintseva p 213–223a refs (See N64-17093 09-17)

18. RESISTANCE WELDING OF TITANIUM P. L. Chuloshnikov p 224–234 refs (See N64-17094 09-17)

19. TWO EXAMPLES OF MACHINING WEAR-RESISTING AND HIGH-TEMPERATURE CORROSION-RESISTANT ALLOYS A. V. Pankin p 235–250a (See N64-17095 09-17)

20. MACHINABILITY OF HEAT-RESISTANT-STEELS AND ALLOYS DURING TURNING, MILLING, AND DRILLING WITH CARBIDE-TIPPED TOOLS N. I. Reznikov p 251–263a refs (See N64-17096 09-17)

21. TEMPERATURE FIELD IN WORKPIECE AND TOOL DURING MACHINING OF HEAT-RESISTANT ALLOYS AND STEELS A. N. Reznikov p 264–283b refs (See N64-17097 09-17)

22. STUDY OF CERTAIN MACHINABILITY FACTORS OF THE HEAT-RESISTANT ALLOY EI617 A. S. Kurochkin p 284–295a refs (See N64-17098 09-17)

23. ELECTRIC-PULSE MACHINING OF HEAT-RESISTANT ALLOYS A. T. Kravets p 296–307a refs (See N64-17099 09-17)

24. HIGH-SPEED MILLING OF HEAT-RESISTANT MATERIALS WITH SPIRAL-TYPE CYLINDRICAL MILLING CUTTERS I. G. Zharkovi p 308–314 (See N64-17100 09-17)

25. INCREASING PRODUCTIVITY DURING MACHINING OF HEAT-RESISTANT STEEL ALLOYS WITH FACE AND END MILLING CUTTERS F. P. Uryvskiy p 315–325a refs (See N64-17101 09-17)

26. FROM FOREIGN EXPERIENCE IN MACHINING STAINLESS AND HEAT-RESISTANT STEELS AND ALLOYS A. Sh. Shifrin p 326–334 refs (See N64-17102 09-17)

27. SERVICE LIVES OF TOOLS DURING MACHINING OF HIGH-STRENGTH METALS D. T. Vasil'yev p 335–344a refs (See N64-17103 09-17)

28. MACHINABILITY OF STAINLESS STEELS DURING TURNING, MILLING AND REAMING Ya. L. Gurevich p 345–358a ref (See N64-17104 09-17)

29. THREAD CUTTING IN COMPONENTS FORMED FROM HEAT-RESISTANT MATERIALS AND TITANIUM ALLOYS O. V. Morozenko p 359–366a refs (See N64-17105 09-17)

30. CERTAIN MACHINABILITY PROBLEMS ENCOUNTERED WITH HEAT-RESISTANT ALLOYS S. A. Golubev p 367–373a refs (See N64-17106 09-17)

N64-17077 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

MODERN HEAT-RESISTANT ALLOYS

I. I. Kornilov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 6–20 (See N64-17076 09-17)

The following conclusions are drawn as a result of investigating the many problems relating to heat-resistant materials: (1) Metals used as a base for the creation of heat-resistant alloys cannot serve as heat-resistant materials in their pure form. (2) Metallic alloys harden as the solid solutions of the metals form, attaining maximum hardening with compositions that correspond to the transitional region from the saturation point to the heterogeneous structures of the alloy. (3) Multicomponent solid solutions of metals show a stepwise increase in heat resistance with increasing number of components in an alloy with a constant maximum heat resistance in the above-noted transitional regions on the diagrams of state of the systems. (4) Experimental diagrams of composition versus the heat resistance of alloys of nickel systems containing from two to six components show the maximum heat resistances that correspond to the optimum compositions of the alloys. Author

N64-17078 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ALUMINIZING HEAT-RESISTANT, HIGH-TEMPERATURE CORROSION-RESISTANT- AND THERMAL-SHOCK-RESISTANT TYPE YaIT, E1435, E1589 AND E1415 MATERIALS FOR PURPOSES OF INCREASING THEIR HIGH-TEMPERATURE CORROSION RESISTANCE

A. S. Stroyev and Ye. L. Zarubina *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 21–31a refs (See N64-17076 09-17)

This paper discusses saturating the surface of high-temperature corrosion-resistant and heat-resistant metal with aluminum to increase resistance to oxidation at high temperatures. It was discovered that this process increases the high-temperature corrosion resistance of the steel sample by approximately 100°. One problem encountered in aluminizing the steels was the lowering of mechanical properties of the materials in tension at temperatures lower than that of scale formation. At temperatures higher than the temperature of scale formation of the alloys in the unprotected state, aluminizing did not lower the mechanical properties. Low-temperature aluminizing does not completely eliminate the corrosion phenomenon of steel at room temperature, but it increases the resistance of steel to this phenomenon to a considerable degree. C.L.W.

N64-17079 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CERTAIN CHARACTERISTIC PROPERTIES OF NICKEL-ALLOY SMELTING

K. Ya. Shpunt *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 32–38 (See N64-17076 09-17)

The influence of chemical composition on certain properties of heat-resistant nickel alloys is investigated. Titanium and aluminum are two of the basic alloying components in nickel alloys; aluminum, on the basis of its physicochemical properties, reduces the oxides of other elements that enter into the composition of the alloy. Aluminum also exerts an influence on the behavior of small additions of elements that exhibit a greater affinity to oxygen. Calcium in the alloy, in the presence of a high aluminum content, results in a sharp reduction of the heat-resistant properties, but when there is no aluminum present and the titanium content of the alloy is very low, the calcium improves the deformability and quality of the alloy. Magnesium was found to exert an effect similar to the calcium; boron and cerium were also found to be affected by a high aluminum content. C.L.W.

N64-17080 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CAST GAS-TURBINE ROTOR BLADES

F. V. Aksenov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 39–52a refs (See N64-17076 09-17)

Attention is given to fabricating and casting gas-turbine blades for turbojet engines. The heat resistance of modern cast materials results in the fabrication of blades that allow an increase in the temperature of the gas in the turbine and an improvement of the technico-economic indicators of engine operation. A technological process is described through which it is possible to fabricate cast components with a minimum number of defects and to guarantee highstrength characteristics of the material in the casting. This process is a method of precision casting from investment patterns. C.L.W.

N64-17081 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THERMOMECHANICAL PROCEDURE OF PRESSURE WORKING HIGH-MELTING HEAT-RESISTANT ALLOYS BASED ON MOLYBDENUM AND CHROMIUM

N. I. Korneyev, I. G. Skugarev, S. B. Pevzner, and Ye. I. Razuvayev *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 53–66 refs (See N64-17076 09-17)

A study was conducted on the plasticity and resistance to deformation of molybdenum and chromium, and alloys of these metals. Also, the development of a procedure for the pressure working of these materials was considered. The study showed that alloys having excessive contamination in the cast state exhibit a reduced plasticity margin in height reduction tests conducted under an impact testing machine and an alloy single-impact height reduction in the range from 15% to 20%. Under this type of loading, high-purity melts underwent 50% to 60% deformation without any indication of brittle fracture. In the predeformed state, alloys have 60% to 70% flat-die reduction prior to brittle fracture at both high and low deformation rates. C.L.W.

N64-17082 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INFLUENCE EXERTED BY WORK HARDENING ON THE ENDURANCE OF HEAT-RESISTANT AND THERMAL-SHOCK-RESISTANT STEELS AT HIGH TEMPERATURES

I. V. Kudryavtsev and B. I. Aleksandrov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 67–86c refs (See N64-17076 09-17)

The influence of work hardening on the endurance and sensitivity to stress concentration in 12 heat-resistant and thermal-shock resistant materials was studied. Tests were conducted, and the effects exerted by various types of deformation were studied. The deformation included tension at room and high temperatures, twisting, upsetting in circular dies under a hammer, surface rolling of components, shot peening, and deformation in the cutting process. As a result of these experimental tests, the influence registered by bulk and surface deformations on the endurance and sensitivity to stress concentration of the materials was established. C.L.W.

N64-17083 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STAMPING-COLD DRAWING OF COMPONENTS FORMED FROM HEAT-RESISTANT SHEET METALS WITH THE USE OF DEEP FREEZING

V. N. Revinov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 87–95a refs (See N64-17076 09-17)

The development of effective technological processes for the working of heat-resistant sheet steels is studied. Stamping–cold drawing, with the use of deep freezing, was given attention. This method allows production of a draw of 2.96 after one operating blow of the die. Intensification of deep drawing due to the low temperatures of the punch increases the efficiency of production and reduces the amount of labor required to adjust equipment. The use of low temperatures only slightly complicates the design of the die. Cooled stamping changes the nature of wall thinning of the workpiece. Thinning is smaller, and its distribution is more uniform than conventional stamping, making possible more rational use of metal and reducing finished piece weight. C.L.W.

N64-17085 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CHARACTERISTIC FEATURES OF THE TECHNIQUE OF SHEET STAMPING HEAT-RESISTANT AND TITANIUM ALLOYS

Yu. P. Davydov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 107–119 (See N64-17076 09-17)

Attention is directed toward the development of a rational technique for the sheet stamping of components formed from heat-resistant and titanium alloys. Fabrication of components formed from these alloys shows departures, in many respects, from the working techniques of such materials as aluminum alloys, carbon steels, and other standard sheet materials. A comparison is given of the basic mechanical properties of various sheet structural materials that exert influence on the stamping process of components. Characteristic features of sheet stamping components formed from heat-resistant and titanium alloys are also discussed, and a comparative evaluation is given of sheet-material stampability. C.L.W.

N64-17086 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

HEADING OF FASTENING STANDARDS FORMED FROM HEAT-RESISTANT STEELS

I. S. Petrov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 120–127 (See N64-17076 09-17)

Studies were conducted by the NIAT and the MAP plants on the cold heading and heading with electric preheating of standard articles formed from heat-resistant steels. The feasibility of cold heading was established, and the technological process of cold heading bolts and rivets formed from steels EI69, 1Kh18N9T, 38KhA, and others was developed. Designs of heading tools that are provided with carbide tips, as well as designs of hard-faced inserts for these tools, were developed. Technological recommendations regarding the preheating of rods and wires formed from heat-resistant steels for purposes of cold heading are given. Technological processes and equipment and tool designs used for heading bolts formed from heat-resistant steels with electric preheating were developed. Author

N64-17087 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PRODUCING STEEL-BLADE PRECISION STAMPINGS BY THE METHOD OF HOT DEFORMATION

M. Ya. Kuleshov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 128–141 (See N64-17076 09-17)

Some results are given from a study concerned with improving the technological process and the equipment used in precision stampings of blades. The refinement of the technological process was developed to obtain precision stampings in terms of thickness, and of scoop twist, of structure and mechanical properties, and of the quality and finish of the surface. The basic operations are also given for a projected scheme for the processing of blades. C.L.W.

N64-17088 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

TECHNIQUE OF FABRICATING TURBINE-BLADE BLANKS FROM HEAT-RESISTANT ALLOYS WITH MINIMUM ALLOWANCE FOR THE SCOOP

Ye. M. Eyfir *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 142–159a refs (See N64-17076 09-17)

Techniques, methods, and equipment utilized in the fabrication of turbine blade blanks from heat-resistant alloys are discussed, with emphasis placed on machining the scoop of the blade. The discussion covers existing technological processes of fabrication, selection of equipment used for stamping blade blanks, and a method of stamping. A scheme of fabrication was given that guarantees the necessary quality of blades. It was

determined that blade blanks should be made without a technological lug at the end of the scoop and that the optimum allowance for machining along the scoop is 0.8 to 1.0 on a side. C.L.W.

N64-17090 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

WELDING TURBINE COMPONENTS FORMED FROM HEAT-RESISTANT ALLOYS

G. A. Nikolayev *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 178–185a refs (See N64-17076 09-17)

Introducing welded design simplifies the shape of turbine component castings, enables the replacement of components with rolled stock, contributes to high metal economy, reduces the volume of machining, and guarantees higher strength characteristics. The development of efficient welding equipment and methods is considered primary and is emphasized along with the selection of proper turbine materials. C.L.W.

N64-17091 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

AUTOMATIC ARC AND MOLTEN-SLAG ARCLESS ELECTRIC WELDING OF HEAT-RESISTANT ALLOYS

B. I. Medovar *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 186–202 refs (See N64-17076 09-17)

Some of the problems encountered in the automatic arc and gas–electric welding of heat-resistant steels and alloys are discussed briefly. A more detailed treatment is given to the technological and metallurgical features of the molten-slag arcless electric welding of these materials with large-section electrodes. C.L.W.

N64-17092 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INERT-GAS SHIELDED ARC WELDING OF HEAT-RESISTANT ALLOYS

Ye. M. Pronina *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 203–212a refs (See N64-17076 09-17)

Results of a search for a welding procedure, and a study of the properties of welded joints in heat-resistant alloys are given. It has been shown by studies and by industrial experience that inert-gas-shielded arc welding is the most rational method of fusion welding as applied to heat-resistant steels and alloys 0.8- to 3.0-mm thick. The principal advantages of this type of welding are: high quality of the welded joints; no need for fluxes; a comparatively small zone of thermal influence; a comparatively minor warping of the workpieces; broad possibilities of mechanizing and automating the welding process; and the possibility of welding without filler wires, thereby lowering welding cost. C.L.W.

N64-17093 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

WELDING OF MARTENSITIC STEEL

G. A. Nikolayev and A. V. Mordvintseva *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 213–223a refs (See N64-17076 09-17)

Experiments were conducted to study the formation of inherent stresses and deformations in welding martensitic steel. The influence exerted by time on the deformation of welded joints in steel containing 0.2% carbon and 13% chromium was studied. Structural stabilization was determined. Attempts were made to eliminate deformation after welding by tempering a buildup specimen in a furnace for one hour at various temperatures. Resistance to crack formation in the welding process and during aging was was determined. A technique of inert-gas shielded arc welding was developed for the purpose of eliminating slagging, obtaining better visual control of the arc, and reducing surface melting of the edges. Tests showed good mechanical properties of the seams that were welded with carbon dioxide shielded arc welding: the residual deformations were approximately equal to the deformations occurring during manual welding; no cracks were detected in the joints. C.L.W.

N64-17094 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

RESISTANCE WELDING OF TITANIUM

P. L. Chuloshnikov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 224–234 refs (See N64-17076 09-17)

The results of studies of spot and seam welding processes for titanium are given, along with the results of mechanical tests of spot- and seam-welded joints in titanium. Allowable maximum deviations were established for the parameters of the welding conditions from the nominal values. Tensile static strength tests and fatigue tests were conducted on the titanium welded joints. Fracture occurred through the around-the-weld zone of the specimens. It was established that the failure of a welded spot joint begins at the junction of the sheets in zones of maximum stress concentration. The fatigue tests showed that a noticeable reduction in the fatigue limit of welded joint occurs that is not due to change in the properties of the metal, but is chiefly a result of local stress concentration on the periphery of the spot, which is associated with the design of the lapped joint. C.L.W.

N64-17095 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

TWO EXAMPLES OF MACHINING WEAR-RESISTING AND HIGH-TEMPERATURE CORROSION-RESISTANT ALLOYS

A. V. Pankin *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 235–250a (See N64-17076 09-17)

Descriptions are given of two specific examples of machining difficult-to-machine alloys: the first concerns the solutions of extremely difficult problems encountered in machining of components used in the aviation and automobile industries, and the second pertains to the search for the improvement of methods employed for studying and solving new problems of a theoretical or practical order that are encountered in difficult cases. In both cases it was proven that derivation of the speed-vs-service life and speed-vs-cutting depth-vs-feed relationships from the wear–time curves is more reliable than derivation of the same dependencies by employing visual criteria. In both examples the specific industrial problems, which hold both technical and economic interest for the aviation and automobile industries, were solved by using special types of hard alloys and active lubricating coolants. C.L.W.

N64-17096 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

MACHINABILITY OF HEAT-RESISTANT-STEELS AND ALLOYS DURING TURNING, MILLING AND DRILLING WITH CARBIDE-TIPPED TOOLS

N. I. Reznikov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 251–263a (See N64-17076 09-17)

A study was conducted on the machinability of chromium stainless steels, heat-resistant chromium–nickel–titanium austenitic steel, heat-resistant nickel-based alloys, and titanium alloys. The materials were subjected to study during turning and facing; cylindrical, end, and disk milling; and drilling. On the basis of resulting data, the relative machinabilities were computed for all of the materials in terms of cutting speed. The materials machined are listed in a table according

to their machinabilities as computed relative to the chromium–nickel–titanium austenitic steel. C.L.W.

N64-17097 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TEMPERATURE FIELD IN WORKPIECE AND TOOL DURING MACHINING OF HEAT-RESISTANT ALLOYS AND STEELS
A. N. Reznikov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 264–283b refs (See N64-17076 09-17)

Theoretical formulas are given for the analysis of the thermal phenomena occurring during the cutting and machining of heat-resistant materials. One equation describes the temperature distribution arising in an unbounded solid under the action of an instantaneous thermal pulse with a power q. Another equation is given that results in a mathematical description of the process of heat propagation from sources of any form that operate continuously or temporarily and that are either stationary or mobile. A formula is also given that is used to calculate the temperature field in a chip during the cutting of a material. The temperature field in the workpiece and in the cutting tool is also covered. C.L.W.

N64-17098 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STUDY OF CERTAIN MACHINABILITY FACTORS OF THE HEAT-RESISTANT ALLOY E1617
A. S. Kurochkin *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 284–295a refs (See N64-17076 09-17)

Attention was directed toward the serious difficulties that arise during the machining of a heat-resistant alloy EI617. Studies were conducted to determine the most advantageous machining conditions, type of tool material, and rational tool geometry that would guarantee the longest service life and highest productivity and machining precision of components of the alloy. Studies were conducted on the influence exerted by the temperature of the blank on its hardness, and on the influence exerted by the machining conditions and by the geometry and material of the tool on the temperature in the cutting zone. Studies were also conducted on the deformation of the layer being sheared, the cutting force, and the wear experienced by the tool. C.L.W.

N64-17099 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ELECTRIC-PULSE MACHINING OF HEAT-RESISTANT ALLOYS
A. T. Kravets *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 296–307a refs (See N64-17076 09-17)

Electric-pulse technique of metal machining is evaluated in terms of its effectiveness as a means of machining components formed from heat-resistant alloys. The rate of metal removal and the quality of the surface being machined were studied. The rate of metal removal was found to be proportional to the average power introduced into the machining zone. In the majority of operations involving shaping of irregular surfaces, electric-pulse machining fails to produce the specified finish; the greatest height of irregularities characterizes that layer of metal that must be removed in order to eliminate traces of electric-pulse machining. Studies were conducted that showed that the height of the irregularities is determined by the pulse energy, and a formula is given that expresses this relationship. C.L.W.

N64-17100 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HIGH-SPEED MILLING OF HEAT-RESISTANT MATERIALS WITH SPIRAL-TYPE CYLINDRICAL MILLING CUTTERS
I. G. Zharkov *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 308–314 (See N64-17076 09-17)

A series of operations were conducted to determine the type of milling cutters that would result in greater productivity in the machining of heat-resistant materials. It was discovered that, in terms of machine time, the productive capacity of cylindrical milling cutters tipped with a hard alloy VK8 is higher than that of carbide-tipped end and face cutters by a factor ranging from 1.2 to 1.5. As compared with some other high-speed cylindrical milling cutters, the carbide-tipped cutter results in an increase in productive capacity in terms of machining by a factor ranging from 3 to 4. C.L.W.

N64-17101 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INCREASING PRODUCTIVITY DURING MACHINING OF HEAT-RESISTANT STEEL ALLOYS WITH FACE AND END MILLING CUTTERS
F. P. Uryvskiy *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 315–325a refs (See N64-17076 09-17)

A study was conducted to find a means of increasing productivity in the machining of heat-resistant steel alloys by determining the optimum geometry of the cutting part of the milling tool, by establishing the optimum type of hard alloy, and by studying the influence exerted by machining elements on service life during machining of heat-resistant steel, heat-resistant nickel-based alloys, and titanium alloys. The study of the geometry of the cutting part of milling cutters consisted in finding the optimum back rake and end-clearance angles, as well as the plane angles and slope angle of the cutting edge. A comparison was made of different types of hard alloys, in terms of their cutting properties, in a series of longevity experiments. The milling cutters possessed optimum geometry and were positioned relative to the workpiece in a manner such that infeed of the cutter teeth occurred with the largest chip thickness, and feedout with the smallest. C.L.W.

N64-17102 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FROM FOREIGN EXPERIENCE IN MACHINING STAINLESS AND HEAT-RESISTANT STEELS AND ALLOYS
A. Sh. Shifrin *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 326–334 refs (See N64-17076 09-17)

This discussion directs attention toward a search for better tool materials and machining conditions for the machining of heat-resistant steels and of titanium and tungsten alloys. In the machining of these alloys, considerable difficulties were encountered because of: (1) the adhesive tendency of these metals that is responsible for seizure between the chips and the rake face of the tool; (2) severe heating of the tool point, due to increased cutting forces and to the low thermal conductivity of austenite; (3) hardening of the metal during shearing and its high abrasive capacity. The machining conditions that are employed in the machining of stainless and heat-resistant steels and alloys are listed. Design and geometry of machining tools are discussed, and cooling–lubricating fluids containing active additives are recommended. C.L.W.

N64-17103 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SERVICE LIVES OF TOOLS DURING MACHINING OF HIGH-STRENGTH METALS

D. T. Vasil'yev *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 335–344a refs (See N64-17076 09-17)

Methods of extending the service life of a cutting tool that is used in the machining of high-strength metals are evaluated. The service life can be prolonged by reducing the vibration amplitude of the tool and components. Several methods are cited for lengthening the service life by increasing the rigidity of the tool. Substitution of shaving tools for cantilevered-type lathe tools lengthens the life of the tool by a factor ranging from 5 to 10. The shortening of drills lowers the vibration amplitude and lengthens the service life of the drill by 60 to 100 holes. Measures that reduce the cutting force are included in the methods that extend tool service. C.L.W.

N64-17104 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

MACHINABILITY OF STAINLESS STEELS DURING TURNING, MILLING AND REAMING

Ya. L. Gurevich *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 345–358a ref (See N64-17076 09-17)

Results are cited of machinability studies of both a martensitic and an austenitic steel. Taken into consideration are the tool material; the tool design and geometry; and the conditions employed during machining. Comparative tests were made of cutting tools that were tipped with different alloys. Materials recommended for tipping cutting tools employed in the machining of both types of steels are given. C.L.W.

N64-17105 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THREAD CUTTING IN COMPONENTS FORMED FROM HEAT-RESISTANT MATERIALS AND TITANIUM ALLOYS

O. V. Morozenko *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 359–366a refs (See N64-17076 09-17)

The poor machinability of heat-resistant alloys and steels and of titanium alloys, during thread cutting, is discussed. Properties of the materials that distinguish two characteristic features of the thread-cutting process are given. One of these features consists in machining in the work-hardened zone, whereas the other consists in the rapid formation, during machining, of buildups of the material on the rubbing surfaces of the tool. Machining in the hardened layer causes an increase in the cutting force, resulting in crumbling of the cutting edges. The buildups cause tool service-life reduction as a result of deterioration of the surface finish of the thread being produced in the workpiece and of the increase in friction. These features distinguish methods of lengthening the service lives of taps as an imperative condition for increasing productivity of the labor involved in threading operations and in their mechanization. The service life of taps can be increased and their jamming eliminated by reducing the load on the tap teeth and increasing their strength and wear resistance, and by protecting the friction surface from buildup. C.L.W.

N64-17106 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CERTAIN MACHINABILITY PROBLEMS ENCOUNTERED WITH HEAT-RESISTANT ALLOYS

S. A. Golubev *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 367–373a ref (See N64-17076 09-17)

The feasibility of improving the machinability of heat-resistant steels and alloys is investigated in terms of physicomechanical properties, when it is known that a definite connection exists between the properties and the machinabilities of these materials. It was determined that a relationship exists between the properties and the machinability of heat-resistant alloys; those alloys that possess increased hardness and strength and less plasticity and toughness exhibit lower machinability. The best correlation appears between the machinability and the heat resistance of the alloy—the higher the heat resistance of the alloy the lower will be its machinability in relation to alloys with a lower heat resistance. The established dependence of the relative machinability upon the properties of the alloy permits the conclusion that the machinability of an alloy can be improved by a corresponding change in the properties. Heat treatment, in accordance with special procedures, softens the material and increases its plasticity, and is the most effective method of improving the machinability of heat-resistant alloys and steels. C.L.W.

N64-17130 McDonnell Aircraft Corp., St. Louis, Mo.

EVALUATION OF THE DELTA TITANIUM-CADMIUM PLATING PROCESS

M. W. Meyer 10 Mar. 1964 34 p
(Contract AF 33(657)-11215)
(A464; AD-431622)

The Delta Titanium–Cadmium plating process was evaluated with respect to its operating characteristics and ability to reduce or eliminate hydrogen embrittlement problems inherent with electroplated high-strength steels. The corrosion resistance of the Delta titanium–cadmium plate was evaluated and compared to cadmium plate from a standard cadmium cyanide bath. The results of the evaluation of the operating characteristics of the new bath showed that it had a 100% anode efficiency and a mean cathode efficiency of 94.6% over a current density range of 20 to 30 amp/ft^2. The mean plating rate over the same current density range was found to be 0.0955 mils/amp-hr based on one square foot of area. Hydrogen embrittlement evaluation utilizing static fatigue notch tensile specimens showed that embrittlement did occur in high strength (300 KSI) steel; however, this could be relieved to some extent by baking the specimens at 375°F for 24 hours. Author

N64-17133 McDonnell Aircraft Corp., St. Louis, Mo.

DETERMINATION OF RESISTANCE WELDABILITY OF TZM MOLYBDENUM ALLOY THIN SHEET

Robert R. Wilcox 10 Mar. 1964 5 p
(Contract AF 33(657)-11215)
(A475; AD-431863)

These limited tests show that resistance spot welds in TZM molybdenum alloy cannot be consistently made without frequent cracking occurring in and around the nugget. Author

N64-17134 McDonnell Aircraft Corp., St. Louis, Mo.

EVALUATION OF LB-2 DIFFUSION – COATINGS ON TANTALUM

T. C. Grimm 10 Mar. 1964 5 p
(Contract AF 33(657)-11215)
(A476; AD-431623)

Tantalum material (0.045-in. thick) can be satisfactorily LB-2 diffusion coated by applying 10 to 20 mils per side of LB-2 base-coat slurry and diffusing per MAC P.S. 13156, Revision C. The 0.006-in. material should be coated employing smaller slurry coating thicknesses than 7 mils per side (perhaps 2 or 3 mils). Author

N64-17135 McDonnell Aircraft Corp., St. Louis, Mo.

EVALUATION OF TUNGSTEN SURFACE FINISH PRODUCED BY ELOX AND ANOCUT MACHINING TECHNIQUES

George Filators 10 Mar. 1964 9 p
(Contract AF 33(657)-11215)
(A477; AD-431620)

Examination of the photomacrographs of the tungsten material cut by Elox equipment, regardless of electrode composition or power setting, revealed it to be rougher and more pitted than the tungsten surface cut by the Anocut equipment. Although the tungsten edge cut with Anocut equipment appears smoother, it shows striations typical of material removal by the abrasive compound embedded in the Anocut electrode. Microcracks penetrating from the cut surface into the tungsten material were evident in each specimen prepared with the Elox equipment, but none were apparent at the surface of the specimen cut with the Anocut equipment. Author

N64-17135 McDonnell Aircraft Corp., St. Louis, Mo.
ELECTROCHEMICAL DEBURRING OF MOLYBDENUM, ALUMINUM AND STAINLESS STEEL
James E. Woolf 10 Mar. 1964 51 p
(Contract AF 33(657)-11215)
(A478; AD-431602)

The criteria of good electrochemical deburring solutions were leveling characteristics and removal rate. Various solutions were evaluated for breaking sharp edges on molybdenum, among them being 25% by weight nitric acid, nitric–hydrofluoric acid solution for milling molybdenum and variations of Turco 105 steel etchant. These solutions were successful in a leveling action on sharp burrs, but would not round the side edges. A combination of nitric acid leveling and side-edge burnishing produced the most promising results. Aluminum and stainless steel deburring was evaluated in proprietary solutions, with good results obtained in polishing and breaking of sharp edges. Author

N64-17137 McDonnell Aircraft Corp., St. Louis, Mo.
THE DEVELOPMENT OF ELECTROFORMING TECHNIQUES FOR WIND TUNNEL MODELS
E. W. Wiggins 10 Mar. 1964 26 p
(Contract AF 33(657)-11215)
(A479; AD-431510)

Techniques of electroforming aerodynamically smooth, lightweight, thin-skinned, improved dynamic- and thermodynamic-response wind-tunnel models were investigated. Two methods of controlling skin thickness and dimensional tolerance of the finished models were investigated. The first method entailed final contour machining, and the second utilized current distribution aids to control the tolerances. Mechanical properties tests and metallographic studies of the electroformed metal were made. In addition to this, hot shortness of the electrodeposit was investigated and was attributed to sulfonated organic stress reducer agents used in the electroplating bath. The results of the electroforming techniques investigation were very favorable and encouraging. Author

N64-17142 McDonnell Aircraft Corp., St. Louis, Mo.
EVALUATION OF THREE METHODS OF APPLYING "SCOTCHCAL" TO ALUMINIZED LACQUERED SURFACES
Final Report
Edward M. Fern 10 Mar. 1964 13 p
(Contract AF 33(657)-11215)
(A484; AD-431514)

Peel strength specimens were prepared to compare the adhesion of the "Scotchcal" to alodined-aluminum, zinc-chromate-primed, and aluminized lacquered surfaces. Two lacquers, MIL-L-7178 aluminized lacquer and color #16473 lacquer, were used. The highest average peel strengths (9.0 lbs per inch) were obtained from the specimens that had been prepared by applying the Scotchcal directly to the aluminized lacquer, after the lacquer had dried 8 to 24 hours. The lowest average peel strengths (5.5 lbs per inch) were obtained from the specimens that had been prepared by applying the "Scotchcal" either to the alodined-aluminum or to the zinc-chromate-primed surfaces. Author

N64-17148 McDonnell Aircraft Corp., St. Louis, Mo.
THE DEVELOPMENT OF ELECTROFORMING TECHNIQUES
Final Report
Paul A. Hamilton 10 Mar. 1964 80 p refs
(Contract AF 33(657)-11215)
(A490; AD-431518)

Mandrel materials selected for evaluation were polystyrene, plexiglass (lucite), cerrotru, polyurethane, and renwood. Nickel was electrodeposited from a sulfamate electroplating bath on the prepared mandrels to the desired thickness. Completed electroformed parts were separated from their mandrels utilizing appropriate techniques. Parts successfully electroformed included a waveguide, a bellows, and a pitot tube. Author

N64-17227* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
WEAR ANALYSIS OF NONLUBRICATED SPUR GEARS
James Clyde Randall Jun. 1963 125 p refs
(NASA Contract NAS7-100)
(NASA CR-53197; JPL-TM-33-139) OTS: $10.10 ph, $3.95 mf

This paper establishes a method of determining wear rates for nonlubricated, fine-pitch, precision instrument spur gears. The concepts of wear and the problems associated with applying these concepts to the unique action of spur-gear surfaces are discussed. Wear data for test gears run at various loads and speeds are collected to determine the wear rates for the most popular materials in use today. A method is proposed for using the wear data to select between two popular methods of computing dynamic load; namely, the American Standards Association Specification B6.11-1951 and Tuplin's method, both of which are slight modifications of Buckingham's original spur-gear formulas. Author

N64-17270 Space-General Corp., El Monte, Calif.
FABRICATION WORK STATEMENT; PROJECT FIRST
J. F. Keville and F. Warren 21 Feb. 1964 30 p refs
(Sponsored by AF)
(SGC-335R-5)

The aim of Project FIRST (Fabrication of Inflatable Reentry Structures of Test) is to develop a completely flexible, inflated paraglider that will be capable of returning a man from orbit by reentering the earth's atmosphere at hypersonic velocity and decelerating to effect a subsonic control landing on earth. Project activity has consisted of determining the critical environment so that materials of construction could be chosen, evaluating and testing the materials, and completing the structural analysis and design of the apex and the leading edge boom of the paraglider. Materials of construction are a woven multifilament nickel–chromium metal fabric and a silicone rubber, which is used to impregnate and coat the fabric forming a gas barrier and ablative coating. R.T.K.

N64-17274 Dow Chemical Co., Denver, Colo. Rocky Flats Div
A METHOD OF STRIPPING AND REPLATING NICKEL ELECTROPLATED URANIUM

W. H. Roberts 9 Mar. 1964 10 p refs
(Contract AT(29-1)-1106)
(RFP-342) OTS: $0.50

The bulk of development work concerned the resolution of the nickel stripping bath. An acidic solution was developed to include both a catalytic agent (mercuric nitrate) to accelerate the removal of nickel and an inhibitor (nickelous nitrate) to retard the reaction with uranium. The final formulation of the stripping bath contains 20 g $Hg(NO_3)_2 \cdot H_2O$ and 20 g $Ni(NO_3)_2 \cdot 6H_2O$ in 250 ml HNO_3, 250 ml H_2SO_4, and 500 ml H_2O. Utilization of this solution under prescribed conditions thoroughly strips nickel and simultaneously etches the uranium substrate, allowing immediate replating from a $NiSO_4$ bath without additional etching steps. Freshly machined uranium test coupons, 2 in. long and 1/4 in. in diameter, were used in the development of the process; no attempt was made to adapt the final process to field specimens of partially corroded fuel elements. Author

N64-17275 General Electric Co., Philadelphia, Pa. Technical Requirements and Analysis Operation
RELIABILITY ANALYSIS DATA FOR SYSTEMS AND COMPONENT DESIGN ENGINEERS. HANDBOOK
S. N. Greenberg 15 Feb. 1963 258 p refs
(TRA-873-74, Rev.)

The topics discussed include: principles of reliability design analysis, procedures for reliability figure of merit analysis, part usage and application data forms, part failure rate data, failure mode, computational methods, derivations, reliability improvement techniques, sample analyses, and statistical and logarithmic tables. R.T.K.

N64-17297 Hanford Atomic Products Operation, Richland, Wash.
TESTS ON REACTOR HELIUM SEALS – PRTR INLET
D. H. White 2 Mar. 1964 18 p
(Contract AT(45-1)-1350)
(HW-76008) OTS: $0.50

A series of developmental tests on five types of high-temperature static gas seals is described. These seals were designed for a helium system operating at a pressure of 4 in. of mercury and at 480° F. Tests of a Zircaloy-2, stainless steel joint helped to define the mechanism of leakage and proved the advantage of certain types of seal designs. The seals tests were designed for a specific application on the Plutonium Recycle Test Reactor to reduce helium losses from the dry-gas system of the reactor, but are of potential use as static gas seals for any gas system operating under similar conditions. Author

N64-17299 Bureau of Mines, College Park, Md. College Park Metallurgy Research Center
ELECTROSTATIC SEPARATION OF HIGH-CONDUCTIVITY MINERALS
Foster Fraas 1964 22 p refs
(BM-RI-6404)

The objective of this research was separation of one highly conductive mineral from a second conductive mineral, a procedure that is impractical in commercial electrostatic separators using metal rolls. A new technique involved use of carrier electrode rolls specially prepared by anodizing and/or oxidizing at high temperatures to form suitable oxide surfaces. Specific oxides included aluminum, copper, and nickel. The significant result provided by the new surfaces was the extension of the separation range to higher conductivities, an extension in relative mineral conductivity from 10^{-14} to 10^{-11} mhos. The results are in accordance with the blocking-layer theory. Author

N64-17310 Arde-Portland, Inc., Paramus, N.J.
DEVELOPMENT OF PRODUCTION TECHNIQUES FOR THE MANUFACTURE OF THE SPARROW ROCKET MOTOR CASE BY THE ARDEFORM PROCESS Final Report
J. J. Cioffi 30 Sep. 1963 138 p
(Contract NOw-62-0730-c)
(AD-430358)

The production technique for the Sparrow Rocket Motor Case was developed successfully. Thirty-one vessels of various configurations were fabricated in order to prove out and develop the various manufacturing approaches used in the production of the nozzle end ring, "belly band," hemispherical heads, and cylindrical section. In order to achieve an acceptable rocket case, extensive tests in the cryogenic stretch pit were conducted. Vessels, burst intentionally or prematurely, were evaluated metallurgically. Those that survived were subjected to hydrotest and/or metallurgical evaluation. Dimensional control of vessels at various stages of manufacture was established by inspecting vessels before and after each stage of cryogenic stretch. Prior to stretching, all welds were radiographically inspected in order to establish acceptable criteria for future vessels. Author

N64-17332 Spacelabs, Inc., Van Nuys, Calif.
DYNAMIC MEASUREMENT OF PROTECTIVE MASKS Monthly Progress Report No. 7, 6 Jan.-7 Feb. 1964
[1964] 4 p
(Contract DA-18-108-AMC-228(A))
(AD-431899) OTS: $1.10

The major effort was concentrated on completing the fabrication, assembly, and test of the first set of portable equipment, including a completely instrumented mask set and backpack. The submodules for the pack were assembled, welded, potted, and tested. A set of submodules were tested with transducers, and data were acquired on the performance of the subsystem over the range of specified pressures and environmental temperature. In general, the performance was within expected limits of accuracy except for the temperature sensitivity of the transducers. Design details, involving the treatment of mask wiring, scale factor and bias adjustment, and mask-battery switching, were worked out in trial assemblies. R.T.K.

N64-17483 SKF Industries, Inc., King of Prussia, Pa. Research Lab.
STUDY OF THE VIBRATION CHARACTERISTICS OF BEARINGS Final Report
Olof G. Gustafsson, Tibor Tallian, Colin Barber, James Huang, John Mc Cool et al 6 Dec. 1963 279 p refs
(Contract NObs-78552)
(AL63L023; AD-432979) OTS: $17.50

Equipment and techniques for measuring vibration characteristics of small ball bearings and of large roller bearings are now available. A mathematical theory of bearing vibration has been developed and presented. This theory relates the amplitudes and frequencies of bearing vibration to its sources. Natural frequencies of the bearing have been computed, and the effect of housing elasticity on the bearing vibration has been analyzed. Experiments have been conducted for the following purposes: (1) to verify the mathematical theory; (2) to study the effect of damping, both within the bearing and in the housing, on bearing vibrations, and to test the feasibility of using special vibration attenuating bearing mounts; (3) to study the effect of rotational speed, and of axial and radial load on bearing vibration; (4) to study the airborne noise of bearings under various loads and rotational speeds and to correlate airborne noise with structureborne vibrations. Author

N64-17484 Army Materiel Command, Washington, D.C.
PROGRAM PLAN FOR ADVANCED TECHNOLOGY OF CAST METALS
25 Mar. 1963 14 p
(AD-432974) OTS: $1.60

Scientific methods for eliminating gross shrinkage defects have been developed. These methods have been refined to include fine interdendritic microshrinkage. Ultrahigh-strength aluminum, magnesium, and steel castings have been made and in one specific application, notably "premium grade" aluminum–silicon–magnesium alloys, castings have been commercially produced. Other recent developments include: (1) new vacuum and inert gas process methods for refining molten metals, (2) further data relating dendrite growth to the freezing process, and (3) determination of the role of impurities and segregation in weakening the cast structure. R.T.K.

N64-17501 Oak Ridge National Lab., Tenn.
HIGH VACUUM FLANGE TEST OF A BAKEABLE ALUMINUM WIRE SEAL
J. D. Redman Mar. 1964 33 p refs
(Contract W-7405-ENG-26)
(ORNL-3509) OTS: $0.75

An experimental program, in support of the ORNL Thermonuclear effort, has been initiated to determine the reliability and reproducibility of flange closure as a function of flange and gasket design for optimum performance in the high vacuum region. This report describes the facility and procedure for such testing and the results of testing wire gaskets of type 1100 wrought aluminum alloy between plane flange surfaces. In this study quality of the vacuum seal was determined at pressures to 1.5×10^{-8} torr (mm Hg) on repeated closure and with thermal cycles between room temperature and 250° C as functions of torque applied, bolt stress, and gasket strain. Author

N64-17514* Mechanical Technology Inc., Latham, N.Y.
COMPARISON BETWEEN THEORIES AND EXPERIMENTS FOR THE THRESHOLD OF INSTABILITY OF RIGID ROTOR IN SELF-ACTING PLAIN CYLINDRICAL JOURNAL BEARINGS
C. H. T. Pan and B. Sternlicht 3 Aug. 1962 39 p refs
(Supported by NASA; Contract Nonr-3730(00))
(MTI-62TR13; AD-282374)

The threshold of Half Frequency Whirl for a rigid rotor in self-acting plain cylindrical journal bearings is analyzed by several methods, and the results are compared. The correlation between the various approaches appears to be good; the simplest method of analysis is, therefore, used for comparison with experimental data. Experimental results showing the effect of bearing length and bearing load are compared with theory. The influence of bearing length on the threshold speed follows similarly as the calculated results. However, the experimental threshold speeds are always a little higher. In comparing the effect of bearing load, it is seen that the calculated threshold speed is consistently somewhat over pessimistic but the influence of rotor inclination is in very good agreement with experiment. Author

N64-17565* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
MECHANISM OF LUBRICATION FOR SOLID CARBON MATERIALS IN VACUUM TO 10^{-9} MILLIMETER OF MERCURY
Donald H. Buckley and Robert L. Johnson Repr. from ASLE Trans., v. 7, 1964 p 91–100 refs Presented at the Lubrication Conf., Rochester, N.Y., 15–17 Oct. 1963
(NASA RP-146)

The friction and wear characteristics of various carbon materials sliding on metals and aluminum oxide were determined in vacuum at ambient pressures from 760 to 10^{-9} mm Hg. The friction and wear experiments were conducted with a hemispherically tipped carbon rider, under a load of 1,000 sliding on various disks rotating at a speed of 390 fpm. The results of this investigation show that additional research on carbon in vacuum is warranted. Adsorbed surface films present on both carbons and metal, as well as the presence of oxide on metals, appreciably influenced the friction and wear obtained with carbons in vacuum. Author

N64-17572* IIT Research Inst., Chicago, Ill.
INTEGRATED WELDING CONTROLS: WIRE FEED – TRAVEL SPEED Jun. 1962–Apr. 1963 [Final Report]
Fred M. Freis 1 Jun. 1963 22 p
(NASA Contract NAS8-2667; Proj. K267)
(NASA CR-53246) OTS: $2.60 ph, $0.86 mf

The report describes the development of an optimum system of welding controls to integrate travel speed and wire feed in the MIG welding process without monitoring both variables independently. The system must control one variable by hand adjustment. The prototype system is described and shown schematically. Author

N64-17616 Du Pont de Nemours (E.I.) and Co., Baltimore, Md. Metals Center
REFRACTORY ALLOY FOIL ROLLING DEVELOPMENT PROGRAM Phase IV Interim Report, 1 Jun.–1 Sep. 1963
John Symonds Wright-Patterson AFB, Ohio, Met. Process. Branch [1963] 21 p refs
(Contract AF 33(657)-8912)
(AD-422001)

Rolling of 12-in.-wide refractory alloy sheets from 0.1-in. to 0.015-in. thickness is described. The five alloys are D-43 (Cb-10%W-1%Zr-0.1%C), B-66 (Cb-5%Mo-5%V-1%Zr), Cb-752 (Cb-10%W-2-1/2%Zr), Ta-10%W, and T-111 (Ta-8%W-2%Hf). Mechanical property and analytical data are included. Author

N64-17617 Du Pont de Nemours (E.I.) and Co., Baltimore, Md. Metals Center
REFRACTORY ALLOY FOIL ROLLING DEVELOPMENT PROGRAM Phase III [Interim Progress] Report, 18 Feb.–20 May 1963
John Symonds Wright-Patterson AFB, Ohio, Met. Process. Branch [1963] 64 p ref
(Contract AF 33(657)-8912)
(AD-418544)

The processing of three columbium-base alloys and two tantalum-base alloys from ingot to 0.100-in.-thick x 12-in.-wide sheet is described. The alloys were Cb-10%W-1%Zr-0.1%C (D-43), Cb-5%Mo-5%V-1%Zr (B-66), Cb-10%W-2-1/2%Zr (Cb-752), Ta-10%W, and Ta-8%W-2%Hf (T-111). The operations involved were: extrusion, hot-rolling, conditioning, annealing, and cold-rolling. Rolling of small sheets of pure tungsten (0.060-in. thick and below) is described. Author

N64-17642 Massachusetts Inst. of Tech., Cambridge Metals Processing Lab.
DEFORMATION PROCESSING OF ANISOTROPIC METALS Progress Report No. 3, 1 Nov.–31 Dec. 1963
D. H. Avery and W. A. Backofen Feb. 1964 3 p ref
(Contract NOw-63-0564-D)
(AD-431969)

Experimental investigations were made of anisotropic metals. Included was a study of the plastic anisotropy in

titanium alloys and sheet steel, and work on the development of plastic anisotropy by control of growth textures in cast material and by introduction of mechanically aligned discontinuities in an otherwise uniform matrix. C.L.W.

N64-17653 Rocketdyne, Canoga Park, Calif.
RESEARCH IN THE FIELD OF LIQUID-METAL-LUBRICATED BEARINGS, PART I
J. Hall and R. Spies Wright-Patterson AFB, Ohio, Res. and Technol. Div. Feb. 1964 77 p refs
(Contract AF 33(657)-10553)
(R-5438, Pt.1; RTD-TDR-63-4289, Pt.1; AD-432451)

A new general purpose test rig (GPTR) was constructed and checked out. The ability to measure bearing operating attitude was developed. The system was calibrated successfully. This new test rig which can support test loads in excess of 100 pounds, has nearly twice the capability of the previous test rig. Antiwhirl journal bearings of the hybrid type were designed and fabricated. Checkout series in the GPTR using water lubricant were performed preparatory to testing with potassium. The design of a special test rig (system simulation test rig) to be utilized in studying rotordynamic characteristics of typical space power systems with antiwhirl bearings was completed. This rig incorporates three potassium-lubricated test bearings, i.e., two journal bearings and one thrust bearing. Author

N64-17660 Du Pont de Nemours (E.I.) and Co., Baltimore, Md.
REFRACTORY ALLOY FOIL ROLLING DEVELOPMENT PROGRAM Interim Report No. 2, 15 Oct. 1962-15 Jan. 1963
John Symonds 1963 37 p
(Contract AF 33 (657)-8912)
(AD-297246)

The melting of three columbium-base-alloy and two tantalum-base-alloy ingots by arc casting is described. The alloys were Cb-10%W-1%Zr-0.1%C (D-43), Cb-5%Mo-5%V-1%Zr (B-66), Cb-10%W-2-1/2%Zr (Cb-752), Ta-10%W, and Ta-8%W-2%Hf (T-111). The process consisted of hydrostatic compaction of elemental powders into electrodes, followed by double consumable arc melting to yield 6-in.-diam. ingots. Analytical and metallurgical testing of the ingots is described. Author

N64-17670* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MONTE CARLO APPLICATION FOR DEVELOPING A DESIGN RELIABILITY GOAL COMPATIBLE WITH SMALL SAMPLE REQUIREMENTS
Ray Heathcock and Dale L. Burrows 22 Jan. 1964 32 p refs
(NASA TM X-51481; MTP-P&VE-T-64-1) OTS: $3.60 ph, $1.16 mf

The reliability of many items in space vehicles (from piece parts to large structural elements) can be appropriately considered to be the result of probability interaction between the distributions of strength (failure) and stress (load). This investigation applies Monte Carlo simulation to the construction of empirical sampling distributions of reliability for various sample sizes taken from the strength and stress distributions, which are assumed gaussian. Emphasis has been placed on very small sample sizes and very high values of reliability, since these are situations commonly imposed on space vehicle development programs because of the costs involved. Author

N64-17693* IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF WEAVE BEAD TECHNIQUES FOR MULTIPASS VERTICAL MIG WELDING OF ALUMINUM ALLOYS Final Report, 2 May 1962-2 Jun. 1963
John F. Rudy et al 6 Aug. 1963 87 p
(NASA Contract NAS8-2676)
(NASA CR-55902; IITRI-B243-13) OTS: $8.10 ph, $2.81 mf

The purpose of this program was to define the parameters of a machine controlled wide-weave technique for performing vertical-up welds in thick aluminum plates, and to develop a machine to perform the automatic weld so defined. To arrive at a welding technique of sufficient latitude that reproducible high quality would be assured, programed oscillation parameters were sought. The first step was to study the techniques of manual welders in performing similar welds. These studies defined oscillation parameters that gave satisfactory welds. A machine to provide these motions was then developed and evaluated as an automatic welding device. Satisfactory welds were made with this machine when simulating the simpler techniques employed successfully by skilled manual welders. Author

N64-17702 Hanford Atomic Products Operation, Richland, Wash. Reactor and Fuels Lab.
DESCALING OF VARIOUS IRON AND NICKEL BASE ALLOYS
H. P. Maffei Sep. 1963 23 p refs
(Contract AT(45-1)-1350)
(HW-79048)

The molten $NaOH$-Na_2CO_3 bath descaled all of the alloys tested at 550° C, 3,000-psi steam. The chemical compositions of the stainless steels, iron–aluminum–chromium base alloys, and nickel base superalloys used in the study are included. Other methods were satisfactory for certain alloy types, but these generally required longer descaling times than the molten-salt-bath method. R.T.K.

N64-17705 California U., Livermore. Lawrence Radiation Lab.
ENGINEERING PROPERTIES AND APPLICATIONS OF NUCLEAR EXCAVATIONS
Louis J. Circeo, Jr. 5 Feb. 1964 50 p refs
(Contract W-7405-ENG-48)
(UCRL-7657) OTS: $1.25

The use of nuclear excavation for engineering projects depends not only on the size of the excavation, but also on the properties of the material in and around the excavation. In a nuclear excavation, several general zones are evident. Among these are the true and apparent crater, crater fallback and lip throwout material, ground upheaval, and the rupture and plastic zones. The properties of the material in these zones are dependent on original medium characteristics and the effects of the detonation. Several applications of nuclear explosives in the highway engineering field appear feasible. These include: (1) excavation of roadway cuts; (2) aggregate production; open pit mining; (3) drainage diversion, or interception by craters; and (4) landslide removal, encouragement, or stabilization. The feasibility of using large yield explosions for engineering projects has been demonstrated in the U.S.S.R. Author

N64-17718 Pratt and Whitney Aircraft, Middletown, Conn.
HARMONIC DRIVE DEVELOPMENT
E. J. Zigmond 18 Mar. 1964 38 p
(Contract AT(30-1)-2789)
(PWAC-412) OTS: $1.00

The harmonic drive was selected as the most practical method for providing rotation of the reactor control drums in the Lithium Cooled Reactor Experiment (LCRE). In addition to providing a zero leak seal, it also embodied a 91.5 to 1 low backlash gear reduction, which simplified the drum drive gear boxes. Author

N64-17786 Industrial Science and Technology Agency, Tokyo (Japan)
A SAMPLED-DATA PROCESS CONTROL COMBINED WITH A CONVENTIONAL CONTROL
Munetaka Jotaki, Ikuo Matsuda, and Akihiko Yagi Aug. 1963 48 p refs In JAPANESE; ENGLISH summary
(*Its* Researches No. 643)

In order to improve computer reliability, a sampled-data control system, combined with a conventional and continuous control system was designed and is discussed. Schematic diagrams are included. R.T.K.

N64-17834 Joint Publications Research Service, Washington, D.C.
SYNTHESIS OF MECHANISMS FOR BURNISHING OF AERODYNAMIC SURFACES
B. V. Shaskolskiy 6 Apr. 1964 18 p refs Transl. into ENGLISH from Tr. Tret'yego Soveshch. po Osnovnym Probl. Teorii Mashin i Mekhanizmov: Analiz i Sintez Mekhanizmov (Moscow), 1963 p 180–194
(JPRS-24052; OTS-64-21996) OTS: $0.50

The conditions for grinding airfoils by the method of burnishing are analyzed. Mathematical relationships are found between dimensions of ground profiles and dimensions of sections of the mechanism. These relationships were calculated by computer for all combinations of parameters. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-16914 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands) Nationaal Lucht- En Ruimtevaartlab.
THE EFFECT OF HIGH TEMPERATURE STRESS AGING ON THE FATIGUE STRENGTH OF 2024/T ALCLAD DOUBLE ROW RIVETED SINGLE LAP JOINTS
A. Hartman and F. A. Jacobs Jun. 1963 14 p refs Performed under contract with the Netherlands Aircraft Develop. Board

A comparison has been made between the fatigue strength at fluctuating tension of 2024-T3 alclad double-row riveted single lap joints at room temperature in the as-fabricated condition and at 150° C after stress-aging for 100 hours. The tests showed an appreciable decrease in endurance of the specimens tested at 150° C, particularly at low stress amplitudes. However, both the fretting pattern of the specimens after dismantling and the location of the fatigue cracks indicated that a secondary effect, probably a decrease of the clamping force due to the aging treatment, was at least partially responsible for the decrease in fatigue strength. Author

N64-16959 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AVIATION PHYSICAL METALLURGY
S. M. Vinarov 19 Aug. 1963 297 p refs Transl. into ENGLISH from the book "Aviatsionnoye Metallovedeniye, Uchebnoye Posobiye", Moscow, Oborongiz, 1962, p 1–220
(FTD-TT-62-1678/1+2; AD-418223)

The book is concerned with the physical nature of metals and alloys, the fundamentals of the theory of their heat treatment, and the behavior of metals and alloys during operation in physical designs. Particular attention is devoted to the properties of the materials at high temperatures. Various alloys are considered from the standpoint of application in aviation engineering: magnesium, aluminum and titanium alloys, structural and stainless steels, heat-resistant alloys, and certain high-melting metals (molybdenum, niobium, and others). Author

N64-16970 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ON THE OXIDATION MECHANISM OF TITANIUM
D. I. Lainer and A. S. Bai 14 Feb. 1964 12 p refs Transl. into ENGLISH from Fiz. Metal. I Metalloved. (USSR) v. 14, No. 2 1962
(RSIC-135; AD-431576)

The microstructure of the scale on titanium oxidized in steam at 800°, 850°, and 900° C and in air at 900°, 1,020°, and 1,150° C was investigated. It was established, by means of inert indicators, that in the oxidation of titanium in steam a bilateral diffusion of oxygen and titanium ions takes place in the scale. A comparison of the structure of the scale on titanium oxidized in air and in steam permitted the deduction that, during the oxidation of titanium in a steam medium, the beginning of intensive diffusion of titanium ions shifts toward considerably lower temperatures than those that occurs during oxidation in air. I.v.L.

N64-16992 Southern Research Inst., Birmingham, Ala.
MECHANICAL AND PHYSICAL PROPERTIES OF TZM MOLYBDENUM ALLOY SHEET AND OF TUNGSTEN SHEET Fifth Quarterly Progress Report, 1 Nov. 1963-31 Jan. 1964
J. A. Hamilton and Clifford L. Dotson 28 Feb. 1964 44 p refs (Contract N600(19)-59530)
(Rept. 6659-1479-5; AD-431114)

Preparation of specimens from tungsten sheet materials was continued. Compression and bend evaluations on the sheet in the recrystallized condition were conducted, and additional bend evaluations on tungsten sheet in the optimum condition were also completed. Tensile evaluations were performed at room temperature and up to 2000° F on the tungsten sheets in the optimum condition; room temperature shear strength determinations were begun. The required specimen blanks for all of the scheduled evaluations on the TZM were sheared from two of the sheet thicknesses to be evaluated. R.T.K.

N64-16996 General Electric Co., Cincinnati, Ohio
HIGH-TEMPERATURE REACTOR MATERIALS FABRICATION RESEARCH
In its High-temp. Mater. and Reactor Component Develop. Programs Vol. I: Materials 28 Feb. 1964 p 15–44 refs (See N64-16995 09-23) OTS: $2.75

A significant number of creep-rupture tests were performed on some of the refractory metals and alloys to 2,800° C in hydrogen and argon atmospheres for as long as 1,000 hours. Certain trends are apparent in the results obtained: (1) The stress-rupture strengths and the linear second-stage creep rates obtained for arc-cast materials are more consistent and reproducible for different sources of the same material than are the results obtained from the same material fabricated by the

powder metallurgy processes. This is particularly true of molybdenum and tantalum. (2) The stress-rupture and creep strengths of powder metallurgy materials are greater than those for the same material processed by arc-melting techniques. (3) The grain size of arc-melted materials exposed in the temperature range from 2,000° to 2,800° C is always huge and ranges from 500 to 900 microns. The grain size of powder metallurgy materials is usually fine, although observed to be duplex at times. An improved processing and fabrication procedure for W-25Re sheet has been developed, which results in a homogeneous (sigma-free) structure. Author

N64-16997 General Electric Co., Cincinnati, Ohio
EFFECT OF RADIATION ON HIGH-TEMPERATURE REFRACTORY METALS AND ALLOYS
In its High-temp. Mater. and Reactor Component Develop. Programs Vol. I: Materials 28 Feb. 1964 p 45–104 refs (See N64-16995 09-23) OTS: $2.75

The objective of this program is to determine the effect of radiation on the time-, temperature-, and stress-dependent properties of selected high-temperature alloys and refractory metals, to identify the causes of any observed changes in these properties, and to develop remedial measures. The materials studied were tungsten and molybdenum and their alloys. Some rhenium specimens were also studied. R.T.K.

N64-17026 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF HEAT RESISTANT ALLOYS
I. P. Bardin, G. V. Kurdyumov, ed., et al 19 Jun. 1963 726 p refs Transl. into ENGLISH from Issled. po Zharoproch. Splavam, Akad. Nauk SSSR, Inst. Met. (Moscow), v. 3, 1958 p 1–430
(FTS-9848/1+2+4)

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N64-17027 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CHANGES IN MICROSTRUCTURE, HARDNESS, AND ELECTRIC CONDUCTIVITY DURING CREEP IN HEAT-RESISTANT GRADES OF STEEL

V. S. Ivanova and I. A. Oding *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 1–14 refs (See N64-17026 09-18)

Creep occurs at all stages as a result of intergranular and intragranular plasticity. Intergranular plasticity may become apparent by simple relative displacement of the grains with their protrusion on the surface of the microsection or by recrystallization and polygonization processes, or else through a special mechanism resulting in the disappearance of twins. The quantitative determination of intergranular plasticity is so far possible only in the case of relative displacement of the grains. The measurement of microhardness and electric conductivity of test pieces subjected to creep showed that the processes of intragranular plasticity play a very effective part during creep. The data obtained on the changes in electric conductivity and microhardness of test pieces during the process of creep agree very well with the dislocation theory of creep in metals. Author

N64-17028 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CERTAIN PROBLEMS IN THE THEORY OF HEAT RESISTANCE

M. V. Pridantsev *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 15–33 refs (See N64-17026 09-18)

Problems concerning the resistance of a material to small plastic deformation are discussed. General factors included in the discussion are: the energy level of the interatomic bond; the strength of the interatomic bond in the crystal lattice; the heat of sublimation; the recrystallization temperature. Factors concerning metals (not alloys) are: the sizes of grains and blocks; degrees of imperfection of the crystal lattice; the number and density of dislocations; and impurities at the grain boundaries. P.V.E.

N64-17029 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CERTAIN PROBLEMS OF ALLOYING HEAT-RESISTANT PEARLITIC STEEL

N. T. Gudtsov, I. F. Zudin, and O. A. Bannykh *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 34–53 refs (See N64-17026 09-18)

At elevated temperatures, tungsten and molybdenum strengthen the α solid solution most effectively. Comparison of their influence in atomic percentages on heat resistance at temperatures of 550° to 600° C shows that tungsten increases heat resistance almost as effectively as does molybdenum. The alloying of steel with tungsten or molybdenum without the addition of elements combining with the carbon into special carbides, in which tungsten and molybdenum are only slightly soluble, can only be effective within a range of concentration that does not result in the formation of carbides other than cementite. An increase in content of the alloying element above the concentration necessary for the carbon to combine completely into a special carbide leads to an increase in heat resistance. Chromium and vanadium are elements that do not effectively increase the heat resistance of steel through the α solid solution. Author

N64-17030 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CONCERNING THE ATOMIC MECHANISM OF AGING IN COMPLEX ALLOYS

I. L. Mirkin *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 54–84 refs (See N64-17026 09-18)

Discussed is research into steels and alloys that are able to operate under considerable stress at high temperatures over a long period of time without breaking down. Most modern heat-resistant steels and alloys have multiple components; and during their service excess-phase crystallites originate and grow in them from the basic supersaturated and supercooled solid solution. There is frequently a phase transition of the precipitated crystallites and the formation of crystallites of a new and more stable phase as well. The process of precipitation of carbide phases in steel (other than of the cementite type), the problem of the precipitation of crystallites of intermetallic compounds in alloys, the thermal mobility of atoms in lattices, and the process of precipitation of the strengthening phases in nonferrous heat-resistant alloys are among the particular areas of research discussed. P.V.E.

N64-17031 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CONCERNING THE RELATIONSHIP BETWEEN THERMODYNAMIC MAGNITUDES AND THE STRENGTH OF ALLOYS AT HIGH TEMPERATURES

M. P. Matveyeva, L. I. Ivanov, and L. N. Bystrov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 85–93 (See N64-17026 09-18)

An investigation to obtain data characterizing the variation in the heat of sublimation of one of the components of a ternary alloy (chromium–molybdenum–iron) and to relate the data to the strength of alloys at high temperatures is discussed. The heat of sublimation and the thermodynamic activity of chromium were experimentally determined in a number of alloys of the iron–chromium–molybdenum system. As a result it is hypothesized that the alloys most resistant at high temperature are those in which the heat of sublimation of chromium has a high value, while the value of thermodynamic activity is at a minimum (which indicates a tendency toward the formation of preferential bonds between heterogeneous atoms). P.V.E.

N64-17036 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SOME RESULTS OF A STUDY OF THE SELF-DIFFUSION OF IRON AND PROBLEMS OF HEAT RESISTANCE

B. M. Noskov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 156–167 refs (See N64-17026 09-18)

It is shown that the alloying components equally influence the self-diffusion of iron and the diffusion of cobalt in iron–cobalt base alloys. From this it is concluded that data on inhomogeneous diffusion may be used to discover the qualitative influence of the alloy components on the strength of atomic interaction. Some results included in the discussion are: (1) An increase up to 4% in the manganese content of iron–cobalt base alloys leads to a constant increase in the diffusion-activation energy, but a further increase (up to 8%) results in a decline. (2) Study of the influence of chromium on diffusion in cobalt–chromium alloys showed that increasing the chromium content up to 7% leads to a rise in the activation energy and self-diffusion of iron. (3) An increase in the nickel content of a cobalt–nickel alloy up to 4% leads to an increase in cobalt's activation energy of self-diffusion, but a further increase in the nickel concentration causes it to diminish. When the nickel content is 30%, the activation energy is even less than the activation energy of self-diffusion in pure cobalt. P.V.E.

N64-17037 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CONCERNING THE CONNECTION BETWEEN DIFFUSION AND HEAT RESISTANCE IN ALLOYS

A. Ya. Shinyayev *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 168–190 refs (See N64-17026 09-18)

A systematic study of diffusion in nickel alloy systems that are the most important from the viewpoint of heat resistance is discussed. The systems studied are the following: (1) Nickel–titanium system—The diffusion coefficient D of iron decreases with an increase in titanium and attains a minimum at 950° C in an alloy containing 8% Ti by weight, and increases with a further increase in Ti. (2) Nickel–chromium–titanium system—Measurement of iron diffusion coefficients at temperatures between 960° and 1,265° C produced a variation in the diffusion annealing time from 300 to 4 hours. A plot of the variation in the diffusion coefficient according to the composition of the alloy shows that at temperatures of 995° to 1,050° C the minimum value is obtained for alloys containing 3.4% Ti by weight. (3) Nickel–chromium–tungsten–aluminum–titanium system—At temperatures of 955°, 1,060°, 1,165°, and 1,250° C, the minimum value of D corresponds to alloys with a titanium content of 3%, 2%, 1%, and 0.5%, respectively. P.V.E.

N64-17044 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STUDY OF CHROMIUM-NIOBIUM-VANADIUM ALLOYS

V. N. Svechnikov, Yu. A. Kocherzhinskiy, V. M. Pan, and A. K. Shurin *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 290–308 refs (See N64-17026 09-18)

As a result of the study of chromium-base alloys containing niobium up to 50% by weight and vanadium up to 10% by weight, which were produced by melting in an induction furnace in an atmosphere of argon, a section of a ternary diagram of phase-equilibria was plotted within the given concentration ranges. The hardness and resistance to scaling of alloys at temperatures up to 1000° C were investigated. At high temperatures (800° to 1000° C), the hardness of binary chromium–vanadium alloys is not only equal to that at room temperature, but is also especially stable. Best among the investigated alloys with regard to hot hardness are those alloys with low contents of both admixtures (niobium, 2% to 5%; vanadium, 5% to 10%), and also the binary alloy containing 30% Nb. However, it is not possible to use alloys containing more than 5% vanadium alloys in an oxidizing atmosphere. Author

N64-17045 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INVESTIGATION OF THE STRUCTURAL CHANGES IN IRON-NICKEL ALLOYS AT THE PHASE TRANSITION

M. I. Zakharova and N. A. Khatanova *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 309–318 refs (See N64-17026 09-18)

The phase transition $\gamma \rightarrow (\gamma + \alpha)$ in iron-base alloys containing 30% to 32% Ni was investigated. The investigation made use of X-ray and microscopic analysis, X-ray photography, and optical and electron microscopes. It was determined that at a temperature of 400° C, this transition proceeds extremely slowly. Cold deformation of alloys at room temperature speeds up the process $\gamma \rightarrow \alpha$. Deformation of an alloy subjected to martensitic transformation at −196° C helps to accelerate the reverse transition $\alpha \rightarrow \gamma$. At temperatures higher than the martensitic point, the initial stage of $\gamma \rightarrow \alpha$ transition follows the usual martensitic transition pattern, and the newly formed layers of the α-phase lie parallel to plane (111) of the γ-phase. At the annealing temperature of 400° C, the coherence of lattices is apparently disrupted during the initial transition stage, and this decelerates the transition process. P.V.E.

N64-17046 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CHANGES IN FINE CRYSTAL STRUCTURES DURING AGING OF NICKEL-BASE AND NICKEL-IRON ALLOYS

G. V. Kurdyumov, I A. Bil'dzyukevich, A. G. Khandros, and V. G. Chernyy *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 319–329 refs (See N64-17026 09-18)

The dimensions of mosaic blocks of the basic solid solution and of the α' phase were determined from the width of the X-ray diffraction lines of the alloys investigated. The dimensions of the mosaic blocks of the basic solid solution of the specimens, quenched in water from 1,080° C, undergo no change with aging temperatures up to 850° C, and are of the order of 7×10^{-6} cm. The α' phase was electrolytically segregated from specimens subjected to the same kind of thermal treatment, and the dimensions of the blocks were determined from the breadth of the X-ray diffraction lines. Attempts to isolate the α' phase electrolytically, after aging at temperatures lower than 700° C, proved unsuccessful. The particles obtained after aging for 4 hours at 700° C were of linear dimensions of the order of 50 A. The amount of α' phase was very small. Particles increased to 350 A with an increase in the aging temperature (850° C at the given soaking), and the amount of α' phase greatly increased. Over the temperature range of 850° to 910° C, the dimensions of the particles (blocks) grow smaller, and, at still higher temperatures, it was not possible to segregate them at all. The amount of α' phase decreases, also, in this temperature range. P.V.E.

N64-17047 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

TEMPERATURE AND TIME-DEPENDENCE OF RESISTANCE TO DEFORMATION IN COPPER AND ITS ALLOYS

M. A. Bol'shanina, M. B. Makogon, and V. Ye. Panin *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 330–359 refs (See N64-17026 09-18)

The mechanical properties of copper and its nickel, aluminum, and zinc alloys in the field of solid solutions are discussed. At temperatures lower than the temperature of recrystallization (and when strain rates are not too low), the sensitivity of the alloys to temperature changes and to changes in strain rates decreases (and has a lower rate and lower temperature coefficient than copper). A qualitative relationship was established within the same temperature ranges between the rate and temperature coefficients, as well as the hardening coefficients of the alloys. At high temperatures and very low strain rates, the change in the bonds of the lattice during alloying becomes considerable (the admixture renders the alloy more stable if it increases the bond strength). There is an analogy between the changes in mechanical properties due to alloying or to change in temperature, as well as the change in the rate of deformation for such high-melting alloys as copper-base alloys, and the laws governing low-melting lead-base alloys. P.V.E.

N64-17048 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STUDY OF THE BEHAVIOR OF NICKEL AND THE SOLID SOLUTIONS OF TITANIUM IN NICKEL UNDER HIGH-TEMPERATURE CONDITIONS AT LOW STRAIN RATES

V. M. Rosenberg *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 360–374 refs (See N64-17026 09-18)

The greater the strength of the interatomic bonds in the crystal lattice of the metal, the greater the time to failure of nickel and its solid solutions, up to temperatures 0.75 or 0.8 of the melting point. At higher temperatures the long-time strength of the metals becomes identical. At high temperatures the slope of the lines linking the logarithm of the time to failure and the degree of the applied stress in the direction of the time axis is less. In slow deformation under conditions of high temperature, fragmentation of the grains occurs in addition to slip. This fragmentation leads to an increase in the diffusion mobility of the atoms in the grain, since the number of internal shear planes is thereby increased. Author

N64-17058 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

EFFECT OF THE DISTRIBUTION OF ALLOYING ELEMENTS ON THE BEHAVIOR OF ALLOYS AT ELEVATED TEMPERATURES

M. Ye. Drits et al *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 511–522 refs (See N64-17026 09-18)

An attempt to establish the relationship between the degree of nonhomogeneity of cast alloys, which occurs during their crystallization, and the behavior of alloys at elevated temperatures is described. The investigation was made by quantitative radioautograph, using the radioactive isotope of Ca^{45}. It was shown that for identical conditions of casting and heat treatment, the intracrystalline heterogeneity of the structure occurring during solidification may vary to a great extent in different alloys. P.V.E.

N64-17059 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INFLUENCE OF ALLOYING ADDITIONS ON THE TEMPERATURE DEPENDENCE OF THE MODULI OF ELASTICITY IN NICKEL AND NICHROME ALLOYS

I. G. Polotskiy, T. Ya. Beniyeva, and Z. L. Khodov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 523–548 refs (See N64-17026 09-18)

The increase in Young's modulus when molybdenum or chromium is added to nickel indicates that the latter strengthens the interatomic bonds in binary nonmagnetic nickel–chromium and nickel–molybdenum alloys. In the case of nonmagnetic alloys containing 6.27 to 12.89 a/o Mo or 10.48 to 23.46 a/o Cr, a higher value is observed for Young's modulus over the whole range of temperatures investigated in alloys with higher concentration of these elements. The deviation from linearity of the temperature dependence of the shear modulus occurs in the same temperature region within which internal friction abruptly increases. Poisson's ratio for nichrome with an addition of 2.5% Ti begins to show a marked increase at 400° to 500° C. Author

N64-17060 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

LAWS GOVERNING THE MECHANICAL STRENGTH OF MATERIALS OBTAINED BY SINTERING OF METAL POWDERS

B. Ya. Pines, A. F. Sirenko, and N. I. Sukhinin *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 549–571 refs (See N64-17026 09-18)

Single and multicomponent powder metal specimens, sintered at the same temperature but soaked for different periods, show a decline in the so-called "transient" mechanical strength with an increase in porosity, which obeys a linear law. The tensile strength of solid specimens may be found by means of linear extrapolation with respect to zero porosity; this value coincides in the case of single-component compacts with the actual value of the strength of cast metals. In multicomponent powder mixtures, including those that form solutions and intermetallic phases, the strength values, extrapolated with respect to zero porosity, are a quadratic function of the concentration. Author

N64-17061 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CERTAIN PROBLEMS RELATIVE TO THE THEORY OF HEAT RESISTANCE

M. Yu. Bal'shin *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 572–583 refs (See N64-17026 09-18)

The volumetric increase and cracking of specimens during cyclic thermal treatment can be explained by a difference in the principles concerning the magnitude and rate of deformation under tensile and compressive stresses. The principle of the dominant influence of the tensile stresses explains the dependence of thermal stability on structure and porosity, as well as the detrimental influence of preferred orientation. This principle can be used to produce the most thermally stable macrostructures by preliminary sintering of powders into granules and other agglomerations. Author

N64-17062 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

BRITTLENESS DURING CREEP

N. Ye. Karskiy *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 584–615 refs (See N64-17026 09-18)

The following topics are discussed: (1) types of deformation and failure during creep—athermic shear, viscous flow of grain boundaries, and viscous flow in grains; (2) certain laws governing the embrittlement of steel during prolonged creep; (3) long-time strength and embrittlement of pearlite steel; (4) long-time strength and embrittlement of austenitic steel; and (5) method for evaluating embrittlement. Some of the conclusions reached as a result of the investigation are as follows: (1) Creep in metallic polycrystals is a combination of three components of residual deformation (athermic shear in the grain, viscous diffusional flow in the grain boundaries, and viscous diffusional flow in the grain. (2) Considerable residual deformation during creep without disturbing the microcontinuity and macrocontinuity of the metal may be obtained only by grain deformation. (3) Viscous flow on the grain boundaries is the cause of intergranular fracture and embrittlement during creep. P.V.E.

N64-17066 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE INFLUENCE OF CHROMIUM ON LONG-TIME STRENGTH OF CHROMIUM-MOLYBDENUM STEEL

O. A. Bannykh and I. F. Zudin *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 647–652 ref (See N64-17026 09-18)

When steel is treated in order to ensure a stable structure (annealing), the slope of the straight line $\sigma - \log \tau$ or $\log \sigma - \log \tau$ decreases as the chromium content increases. The existence of a clear time dependence of the relative variation in the value of the ultimate longtime strength is an advantage when the steel is working under stresses higher than the prescribed maxima. Consequently, whenever there is instability in the service stresses (the ultimate longtime strength over 100,000 hours being equal), steel with a lower chromium content should be more reliable in service. The sharp temperature dependence of the relative variation in the value of the ultimate longtime strength, observed in steel with a low chromium content, is a disadvantage when the service conditions of the steel involve the possibility of temperature variation in time. The higher the chromium content in steel, the less effect overheating will have on the level of the longtime strength. Author

N64-17067 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INVESTIGATION OF THE RESISTANCE TO PLASTIC DEFORMATION IN ALLOYS OF THE NICKEL-IRON SYSTEM

K. A. Osipov and Ye. M. Miroshkina *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 653–660 (See N64-17026 09-18)

The resistance to plastic deformation of solid solutions of the iron–nickel system was studied by the hot-hardness method at temperatures of 850° and 1000° C. It was established that those solid solutions, which, by their composition, correspond to the central part of the diagram of state, have the greatest creep rate at these temperatures. No well-defined conclusion concerning the heat resistance of alloys could be made on the basis of the parameters of self-diffusion of iron in iron–nickel solid solutions obtained for an unstressed state in the absence of plastic deformation. Author

N64-17068 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

HEAT RESISTANCE AND HOT-HARDNESS OF ALLOYS OF BINARY SYSTEMS OF NICKEL WITH CHROMIUM, MOLYBDENUM, AND TUNGSTEN

I. I. Kornilov and N. T. Domotenko *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 661–674 refs (See N64-17026 09-18)

An increase in concentration of the elements in the solid solution of nickel results in an increse in the heat resistance and hot hardness of the alloys. There is a direct connection between the chemical composition of alloys, the nature of the phases, and heat resistance in the temperature range under study. The zone in which alloys with highest heat resistance exist depends on these phase transitions, which take place in the system during temperature variation. Author

N64-17071 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STRUCTURE AND PROPERTIES OF CARBONITRIDED CHROMIUM

V. N. Konev *In its* Invest. of Heat Resistant Alloys 19 Jan. 1963 p 698–706 refs (See N64-17026 09-18)

It was established that during the carbidization of chromium plating in an atmosphere containing nitrogen, three different layers were formed: (1) an outer layer of rhombic chromium carbide Cr_3C_2; (2) an intermediate layer of hexagonal chromium carbide Cr_7C_3; and (3) an inner layer of hexagonal chromium nitride Cr_2N. During formation of the Cr_2N layer, a texture corresponding in orientation and size to the textured chromium can be detected at all temperatures. Reaction diffusion in a chromium–nitrogen–carbon system is brought about through the diffusion of nitrogen and carbon atoms into the metal through the nascent layer. The front along which the reaction between the nitrogen and chromium takes place is located on the interphase boundary $Cr–Cr_2N$, but the front of the reaction between the carbon–chromium is on the interphase boundary $Cr_2N–Cr_7C_3$. The presence of an interphase boundary between Cr_2N and Cr_7C_3 points to the limited mutual solubility of these phases. Author

N64-17072 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THERMAL AND ELECTRICAL PROPERTIES OF COPPER, SILVER, GOLD, ALUMINUM, AND ALLOYS WITH A COPPER BASE
V. Ye. Mikryukov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 707–721 refs (See N64-17026 09-18)

Heat is transmitted in metals, alloys, and semiconductors by two processes: electronic conductivity and lattice conductivity. Since the investigated metals (copper, silver, gold, aluminum, and alloys with a copper base) are rated as good electrical conductors, their lattice heat conductivity is a small quantity compared to the electronic conductivity. The observed value of the Wiedemann–Franz ratio agrees in this case with the calculated value, since the heat conductivity of the lattice of these metals and alloys is within the error of measurement. In alloys that are good conductors, the Wiedemann–Franz ratio does not depend on the state of heat treatment or cold working of the specimen. The thermal conductivity can be calculated theoretically from the measurement of the electrical conductivity in any state. The heat conductivity and electrical conductivity will depend on the heat treatment and cold working of the specimen. Author

N64-17084 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TECHNOLOGICAL PLASTICITY AND MECHANICAL PROPERTIES OF TITANIUM ALLOYS AS FUNCTIONS OF HOT DEFORMATION CONDITIONS
V. Ya. Kleymenov and T. N. Sazonova *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 96–106 (See N64-17076 09-17)

Studies were centered on the determination of the technological plasticity of titanium alloys. These studies included: the method of investigating the impact strength as a function of test temperature; the establishment of an allowable degree of deformation as a function of temperature by means of a height reduction on a vertical impact testing machine; and the determination of the average specific pressures as a function of the temperature, degree, and rate of deformation. Optimum conditions are given for hot deformation of titanium alloys, provided that the deformation is dynamic. Static deformation conditions present more favorable hot deformation conditions for titanium alloys. In this case, technological plasticity increases sharply, and resistance to deformation diminishes. C.L.W.

N64-17089 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CHARACTERISTIC FEATURES OF HOT STAMPING TITANIUM ALLOYS
L. A. Nikol'skiy *In its* The Working of Heat-Resistant Alloys 26 Nov. 1963 p 160–177a ref (See N64-17076 09-17)

Hot stamping of blanks formed from titanium alloys was studied. The experiments were duplicated on aluminum alloys, steels, and magnesium alloys to compare and ascertain more fully the technological features of titanium alloy stamping. Experiments showed that blanks formed from titanium alloys cooled more rapidly than blanks formed from steel at the same deformation temperatures. The influence exerted by the heating temperatures of dies on the deformation-resistance ability of aluminum alloys, titanium alloys, and steel was investigated. Titanium alloys were found to exhibit a higher tendency to adhere to the surface of the die. Studies aimed at establishing technological parameters of hot stamping under hammers, on presses, and on horizontal forging machines showed that, in spite of good plasticity, stamping of titanium alloys is difficult because of their tendency to adhesion and the rapid surface cooling of the blank in the forming process. C.L.W.

N64-17131 McDonnell Aircraft Corp., St. Louis, Mo.
EVALUATION OF BRAZING ALLOYS FOR THE FABRICATION OF INCONEL 718 HONEYCOMB SANDWICH PANELS
Frank J. Coffey 10 Mar. 1964 33 p
(Contract AF 33(657)-11215)
(A469; AD-431616)

A nickel-base structural alloy, Inconel 718, has been considered for use in the fabrication of honeycomb structures capable of sustained operation at elevated temperatures. Four gold-containing braze alloys were selected for compatibility testing with Inconel 718 base metal. From the results of these tests Premabraze 128 and Premabraze 130 braze alloys appeared to be suitable for honeycomb structure brazing with Inconel 718 as base metal. No evidence was found to indicate that either of these braze alloys are susceptible to crevice corrosion. The Nicoro and Incuro 20 braze alloys were eliminated from testing because of inferior wettability and flow characteristics. Author

N64-17132 McDonnell Aircraft Corp., St. Louis, Mo.
EFFECT OF VARIOUS ANNEALING CYCLES ON INCONEL 718 MICROSTRUCTURE
R. Newcomer 10 Mar. 1964 38 p refs
(Contract AF 33(657)-11215)
(A470; AD-431618)

Metallographic studies were performed to investigate the effect of various annealing cycles on grain size and precipitate morphology in Inconel 718 nickel–chromium alloy. Test specimens of 0.040-in. material were overaged at 1,400° F for 30 hours and then annealed 15 minutes at 1,500°, 1,600°, 1,750°, 1,800°, 1,900°, 2,000°, 2,100°, and 2,150° F. Before and after aging, the DPH hardness of all materials was determined, and photomicrographs at 250X and 2,000X were prepared. Annealing between 1,700° and 1,800° F adequately dissolves precipitated phases so that subsequent aging produces maximum hardness. Annealing overaged material at 1,900° F for 15 minutes appears to completely dissolve precipitate phases without altering precipitation behavior during subsequent aging or encouraging excessive grain growth. When annealed at temperatures greater than 1,900° F, excessive grain growth can be expected. Precipitation behavior during subsequent aging appears different with grain-boundary films forming. Author

N64-17138 McDonnell Aircraft Corp., St. Louis, Mo.
EVALUATION OF SKID ABRASION RESISTANT MATERIALS
J. F. Krieg 10 Mar. 1964 54 p
(Contract AF 33(657)-11215)
(A480; AD-431625)

This program was conducted in an attempt to eliminate costly replacement of equipment platforms and runners subjected to skidding abrasion on concrete surfaces. It was desired to determine which of the 12 materials investigated (including 8 metals and 4 nonmetals) would be most suitable for use as wearing pads to be attached to the bottom of platform runners. The samples were subjected to drag runs of 50, 100, 200, and 500 ft. Runs were made on a concrete surface at surface pressures of 33 and 119 psi and at drag speeds of 5 and 15 mph. The forces required to initiate and maintain motion of the different materials on the concrete surface were also measured. The relative magnitude of sparking among the different materials was determined. On the basis of the test results, Haynes-Stellite Alloy No. 1 was found to have the best wear resistance of the 12 materials tested. The relative sparking of this alloy was slight. Author

N64-17139 McDonnell Aircraft Corp., St. Louis, Mo.
DETERMINATION OF LAP SHEAR PROPERTIES OF ADHESIVE NO. 18 FROM G. C. BORTHIG CO.
Henry E. Ricking 19 Dec. 1961 5 p
(Contract AF 33(657)-11215)
(A481; AD-431511)

Adhesive number 18 as indicated by the test results exhibits a higher lap shear strength at temperatures of 250°, 300°, and 350° F than at room temperature. Test results also indicate that the maximum lap shear strength was attained at an elevated temperature of 300° F, with higher temperatures resulting in a lower lap shear strength. Author

N64-17140 McDonnell Aircraft Corp., St. Louis, Mo.
DETERMINATION OF TENSILE LAP SHEAR STRENGTHS OF SEVERAL METAL-TO-METAL AND METAL-TO-LAMINATE CONFIGURATIONS
J. Swafford 10 Mar. 1964 8 p
(Contract AF 33(657)-11215)
(A482; AD-431512)

Test data compiled previously indicated that the corner couch specimens fabricated from production parts (metal-to-laminate configuration) are not developing expected strengths. This test program was initiated to compare the previously compiled data and to obtain data on alternate cleaning procedures and bonding materials to be used. Tensile lap-shear strengths were determined for several metal-to-metal and metal-to-laminate bonding configurations, and two cleaning procedures were investigated. A comparison of the results obtained previously and this test revealed that bond strengths obtained from specimens fabricated from production parts were abnormally low. Author

N64-17208 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
POWDER METALLURGY Review of Recent Developments
V. D. Barth 17 Jan. 1964 4 p refs

A three-layer (copper–iron–copper) strip has been experimentally produced by the simultaneous roll compaction of iron and copper powders in a vertical feeding arrangement. In bending tests over vise jaws of 2-mm radius, three-ply strips withstood more than 100 reverse bends. A bimetal disk composed of sintered copper powder on nickel or a nickel-base alloy has been extruded to form a cored electrode. Heckel's equation was found to be one of the best metal-powder-pressing equations for expressing pressure-density relationships. The calculation of forces producing sintering as a function of surface tension has been demonstrated. Large-volume expansions due to the Kirkendal effect have been measured in sintering experiments on synthetic wire compacts composed of the combinations Cu-Ni, Au-Ni, Fe-Ni, and Ag-Cu. Precipitation of vacancies at surfaces as well as plastic flow, caused by unequal diffusion, were observed. Iron powder along with oil without additives is said to be the best combination for self-lubricated, sintered porous bearings. The presence of a liquid phase with the complete wetting of the solid phase is the condition for the so-called process of slip shrinking and the inhibition of grain growth in the tungsten carbide in a sintered WC-Co alloy. I.v.L.

N64-17209 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
HIGH-STRENGTH STEELS Review of Recent Developments, 15 Jul.-15 Oct. 1963
H. J. Hucek 1 Nov. 1963 2 p refs

Recent developments concerning high-strength steels are reviewed. A new heat treatment for the secondary-hardening steels, H-11 and AISI Type 422 stainless steel has been developed. The tempering is conducted at temperatures in the 500° to 600° F range. The new treatment resulted in an increase in fracture toughness at no sacrifice in strength. This increase is important in many aerospace applications where both high strength and toughness are desirable. The mechanical properties of the new steel, HP-0-4-X alloy, can be imporved by special processing methods. This special processing involves austenitizing and hot–cold working in the 1600° to 1200° F range prior to quenching to room temperature. The treatment, on the other hand, of the 18%-nickel maraging steels, involves cold rolling and subsequent aging. By this processing, ultimate strengths as high as 370,000 psi can be obtained for HP-9-4-X steel, and 310,000 psi for the 18%-nickel steels, with fracture toughnesses equal to that of low-alloy steels treated to less than 240,000 psi tensile strength. A fracture model is proposed for high-strength steels. This model explains ductile crack extension as microshearing within a three-dimensional array of finely divided defects such as inclusions or micropores. I.v.L.

N64-17210 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
NICKEL-BASE AND COBALT-BASE ALLOYS Review of Recent Developments
D. A. Roberts 22 Nov. 1963 2 p refs

A program to develop experimental data relative to the use of metal filaments in high-temperature fabrics has been completed. Results show that the nickel-base, precipitation-hardened alloy wires containing molybdenum (Udimet 500, Udimet 700, M-252, and René 41) to have the highest hot strengths—17,000 to 23,000 psi at 2,200° F. Udimet 500 and 700 alloy wires were the strongest tested, but showed the lowest ductility. Wires showing considerable ductility were René 41, Haynes Alloy No. 25, Inconel 702, Karma, and Elgiloy. Hastelloy X exhibited the best high-temperature ductility, 17.6% at 2,200° F, but its strength was only 13,000 psi at this temperature. Inconel 702, Chromel R, and Karma wires possessed the best combination of high-temperature strength, ductility, and creep and oxidation resistance. However, Inconel 702 is difficult to draw and 1.0-mil

wire was the smallest size obtainable. Chromel R and Karma wire are available in diameters down to 0.5 mil. Tensile strength and diffusion tests on coated thin sheets of the superalloys, Inconel, René 41, Haynes Alloy No. 25, S-816, and Hastelloy C indicated that the Haynes alloy developed the highest strength at the test temperature of 2,000° F, while Inconel exhibited the best coating compatibility. I.v.L.

N64-17211 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

METALS JOINING Review of Recent Developments, 16 May-15 Nov. 1963

R. M. Evans 29 Nov. 1963 3 p refs

The electron-beam welding of the D-14 (Nb) alloy has resulted in butt welds having a 66,000-psi ultimate strength, a 54,000-psi yield strength, and a 6.6% elongation. Lap-shear strengths averaged 723 lb/linear in. of weld, and were independent of metal thickness, with the failures always occurring in the heat-affected zone. Corrugated-panel properties were influenced by erratic penetration of the welds. Thin tungsten sheet was joined with pure tungsten when a tungsten hexafluoride–hydrogen mixture was directed into the joint area that was heated by conduction to about 1,200° F. Fine-grain structure in the joint and an absence of a heat-affected zone appear to be the advantages. Significant increases in quenching rate and decreases in the width of the heat-affected zone were obtained by using refrigerated liquid-cooled backup and hold-down bars during the welding of 2014-T6 and 2024-T86 aluminum sheet. As a result, joint efficiencies exceeding 90% in 2014-T6 and better than 85% in 2024-T86 were obtained without post-weld solution or aging treatments. Aluminum-to-aluminum honeycomb structures can be vacuum brazed at 150° F below the melting temperature of the base material. The use of flux-less aluminum–silicon material is the key to the process. I.v.L.

N64-17212 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

TITANIUM AND TITANIUM ALLOYS Review of Recent Developments, 24 Aug.-22 Nov. 1963

R. H. Ernst and R. A. Wood 13 Dec. 1963 6 p refs

Recent developments in titanium and titanium alloys are reviewed. Fatigue tests at cryogenic temperatures of −320° and −423° F showed the superior fatigue behavior of extra-low interstitial content grades of Ti-5Al-2.5Sn and Ti-6Al-4V compared with Ti-13V-11Cr-3Al. Hazards in using the Ti-6Al-4V alloy as tankage material for nitrogen tetraoxide (NTO) are: (1) Sporadic, violent reactions occurred when the alloy, exposed to NTO, was mechanically shocked (but not punctured) with an impact energy of 40 ft-lb or more. Frequency of reactions increased with the energy level of the impact shock. (2) Alloy filings on the impact surface of specimens initiated reactions at lower shock-energy levels. Results of 28-day corrosion studies of Ti-6Al-4V in NTO are: (1) Corrosion rates at 70° F averaged about 0.005 mg/ in^2/day. Attack appeared to reach a maximum after 1 week. (2) A gelatinous precipitate formed during corrosion could affect the functioning of the filters and valves in propulsion systems. (3) Temperatures to 140° F appeared to have little effect on the corrosion rate. (4) Forged, machined, or ground RMS-125, or chemically milled surfaces had nearly equivalent corrosion rates. (5) Galvanic corrosion of the alloy appears to be significant in NTO. The mechanical properties of 1/2-in.-thick plate of new compound-free beta alloys, Ti-12Mo-(4, 6, or 8 Sn) have been determined. I.v.L.

N64-17213 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

EVALUATION OF SPECIAL METAL PROPERTIES Review of Recent Developments, Sep.-Nov. 1963

J. E. Campbell 20 Dec. 1963 4 p refs

Recent developments in the evaluation of special metal properties are reviewed. The effects of shallow cracks on the fracture strengths of transverse specimens of annealed Ti-6Al-4V (0.050-in. thick), annealed Ti-5Al-2.5Sn (0.050-in. thick), and 2014-T6 aluminum alloy (0.100- and 0.250-in. thick) at room temperature and at −423° F are described. The fatigue properties at 70°, −320°, and −423° F in the 10^3-to 10^7-cycle range have been determined for the titanium alloys: annealed TI-5Al-2.5Sn ELI, solution-treated and aged Ti-6Al-4V ELI, and solution-treated and aged Ti-13V-11Cr-3Al and for the aluminum alloys: 2014-T6, 2219-T87, 5456-H343, 2020-T6, and 7075-T6. Data on tensile tests in liquid helium for annealed specimens of plate AISI Types 301, 310, 316, and 347 stainless steel are discussed. Optimum materials, selected on the basis of notched and unnotched tensile tests conducted over the range from 800° to −423° F, for use in liquid-hydrogen-fueled aerospace vehicles were: annealed Hastelloy X for the external structure, annealed Ti-13V-11Cr-3Al for the insulated structure, cold-rolled Type 301 stainless steel for the liquid-oxygen tankage, and annealed Ti-5Al-2.5Sn ELI for the liquid-hydrogen tankage. Fracture testing is discussed, as are the effects of explosive strain rates on 2219 aluminum alloy (T37 and T87 conditions), annealed Ti-5Al-2.5Sn, and René 41 nickel alloy. I.v.L.

N64-17214 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS Review of Recent Developments, 9 Sep.-9 Dec. 1963

J. A. Houck 27 Dec. 1963 2 p refs

Recent developments in molybdenum and molybedenum-base alloys are reviewed. TZM alloy has been processed to final mold-out (thickness range from 0.085 to 0.151 inch). The cracking problem that resulted was eliminated in subsequent rolling operations by recrystallization of the sheet bar before rolling. InFab atmosphere-purity studies were conducted on TZM alloys strips. The material was held at temperatures of 1,000°, 2,000°, and 3,000° F for periods of 1 min, 6 min, and 1 hr. The object was to evaluate the degree of protection afforded by the InFab atmosphere. Results of a cursory evaluation of the exposed samples showed all of the strips to be clean and bright after exposure, except for one sample. Two high-strength molybdenum alloys, Mo-1.59Nb-0.52Ti-0.21Zr-0.068C and Mo-1.3Ti-0.35Zr-0.093C, have been vacuum-arc melted and converted to 0.05-in.-thick sheet. The minimum temperature to attain complete recrystallization in 15 min in the 0.05-in.-thick sheet was 3,000° and 3,200° F, respectively. Bonding processes have been developed for the TZM alloy. Bonded joints were produced in 0.012-in.-thick sheet in 300 sec at 2,400° F, with a pressure of 25,000 psi. This bonding temperature and pressure can be reduced by using a 0.001-in.-thick tantalum intermediate foil. I.v.L.

N64-17215 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

COLUMBIUM AND TANTALUM Review of Recent Developments

E. S. Bartlett and F. F. Schmidt 10 Jan. 1964 4 p refs

Recent developments in niobium and tantalum are reviewed. Data on the tensile properties of thin in-process sheet

(12 to 15 mils thick) of various Nb and Ta alloys are presented in both the cold-worked (84% to 90% reductions) and recrystallized (about 1 min at 2,450° F for Nb alloys and 1 min at 2,850° F for Ta alloys) conditions. The Nb alloys are D43 (Nb-10W-1Zr-0.1C), B66 (Nb-5Mo-5V-1Zr), and Nb752 (Nb-10W-2.5Zr). The Ta alloys are Ta-10W and T-111 (Ta-8W-2Hf). These data are unique in that they present a valid comparison of strengths of the alloys in conditions of very similar mechanical and thermal history. A feasibility study of extrusion-tube reduction processes for producing seamless high-strength Nb-alloy tubing was conducted, using B66 and D43 alloys. The B66 alloy was not reduced successfully from tube blanks to finished tubing at room temperature. However, D43 was successfully drawn at room temperature to produce the following tube sizes: 78 ft of 1/2-in. OD × 0.060-in. wall, 77 ft of 3/8-in OD × 0.060-in. wall, and 356 ft of 1/4-in. OD × 0.018-in. wall. A carburized Ta-10W alloy has been obtained that has the optimum combination of fabricability, ductility, and erosion resistance for nozzle applications. The tensile and stress-rupture properties of T222 (Ta-9.6W-2.4Hf-0.01C) are summarized. I.v.L.

N64-17216 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

OXIDATION-RESISTANT COATINGS FOR REFRACTORY METALS Review of Recent Developments

J. J. English and W. A. Gibeaut 24 Jan. 1964 4 p refs

Recent developments regarding oxidation-resistant coatings for refractory metals are reviewed. Based on the weight changes, temperature had little effect on the rate of oxidation of bulk $MoSi_2$ in pure O_2 at temperatures of from 1,120° to 2,650° F; below 2,200° F, varying the oxygen pressure between 0.01 and 1 atm did not yield a systematic effect on the oxidation rate. "Pest" oxidation occurred on $MoSi_2$ at temperatures below 1,100° F, and the resulting oxidation product was identified as tiny crystals of MoO_3 and amorphous SiO_2. The oxidation failure of a $MoSi_2$ coating became imminent when Si-diffusion depletion changed the principal coating layer to Mo_5Si_3 phase. A proprietary coating, designated LGC-2, has been developed and evaluated primarily over TZM alloy. A summary report has been issued by GT&E on the oxidation of Zr-Th, Zr-Y, Hf-Y, Hf-W, Hf-W-Re, Sn-Al-Cr, and Sn-Al-La alloys as well as ZrN, HfN, and ZrN-ThN combinations. Emission measurements are given for PFR-6, Vought IV, Durak B, Durak MG-F, and Durak KA coatings. I.v.L.

N64-17219 Naval Research Lab., Washington, D.C.

FRACTURE TOUGHNESS OF METALS

J. M. Krafft *In its* Rept. of NRL Progress, Nov. 1963 1963 p 4–16 (See N64-17217 09-01) OTS: $1.25

A deliberate restriction of conditions for the crack "reinitiation" test to maximum constraint or plane strain has led to promising insights into the nature of fracture. With this limitation, the measure of fracture toughness becomes completely independent of specimen dimensions and thus a useful criterion of material performance. The stress intensity factor for unstable crack growth has been found to be directly related to the strain for tensile instability, expressed by the strain hardening exponent n. This proportionality focuses attention on a small but fixed zone d_γ in advance of the crack tip, in which the metal is ruptured by the concentration of tensile strain at levels greater than n. The size of this zone is seen to be closely related to (1) effects of loading rate and crack speed on fracture toughness and (2) fatigue loading crack growth rates. Author

N64-17237 Los Alamos Scientific Lab., N. Mex.

HOMOGENIZATION OF GALLIUM-STABLIZED DELTA-PHASE PLUTONIUM

Kaye Allan Johnson 28 Feb. 1964 45 p

(Contract W-7405-ENG-36)

(LA-2989) OTS: $1.00

The homogenization behavior of cast gallium-stabilized delta plutonium was investigated and characterized by metallographic and electron microprobe techniques. Approximate diffusion data for gallium in delta plutonium were calculated from parameters of the homogenization process. For comparison, the homogenization behavior or rolled, relatively impure gallium-stabilized delta plutonium was investigated. The effects of heat treatment in the epsilon temperature region and cooling through the delta-plus-epsilon field were also investigated. Author

N64-17258 International Nickel Co., Inc., Huntington, W. Va. Huntington Alloy Products Div.

ENGINEERING PROPERTIES OF INCONEL ALLOY X-750

[1963] 40 p refs

(*Its* Tech. Bull. T-38)

Inconel alloy X-750 is an age-hardenable, Ni–Cr alloy used for its corrosion and oxidation resistance and high creep-rupture strength at temperatures up to 1500° F. Among the areas discussed in this report are: (1) metallurgy and microstructure; (2) the effects of various heat and aging treatments on the mechanical properties of bars, plates, tubes, wires, springs, and bolts made from this alloy; (3) the rupture, tensile, compressive, and cryogenic-temperature properties, and the fatigue, shear, and fracture strength of sheets and strips of this alloy; (4) wire forming, forging, deep drawing and spinning, the fabrication of airframes, and machining; (5) pickling and descaling; (6) joining; and (7) available mill products. I.v.L.

N64-17276 North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

AEROSPACE CORROSION AND MOISTURE PROBLEMS: A REVIEW OF THE RESEARCH REPORTS [1960-1964]

J. R. Linger 20 Jan. 1964 268 p 634 refs

(SID-64-11)

This report is a bibliography of research reports on corrosion and moisture problems in the Aerospace industry published from 1960 to date. Foreign language references are included. Author

N64-17289 ManLabs., Inc., Cambridge, Mass.

THERMOMECHANICAL TREATMENTS APPLIED TO ULTRA-HIGH-STRENGTH BAINITES Fifth Progress Report, Oct. 15-Dec. 15, 1963

[1963] 27 p ref

(Contract N600(19)-59811)

(AD-430911)

Retained austenite determinations were made in H11 that had been subjected to various thermal and thermomechanical treatments. It was found that up to 35% austenite is retained when bainite is formed at 550° F from either deformed or undeformed austenite. For tempering temperatures below 1,000° F, retained austenite has a considerable effect on the yield strength of the mixed structure. The influence of retained austenite on the yield strength is not directly proportional to its volume percent. Author

N64-17298 Battelle Memorial Inst., Columbus, Ohio
A STUDY OF THE TENSILE FRACTURE AND MICROSTRUCTURE OF URANIUM
Fred R. Shober, Norman E. Daniel, Ellis L. Foster, Jr., Arthur A. Bauer, Clarence R. Thompson et al 14 Feb. 1964 79 p
(BMI-1664) OTS: $2.00

Tensile tests and exhaustive metallographic examinations were conducted in an effort to relate the mechanical properties, the chemical compositions, and the structures of five grades of SRL uranium to their irradiation stability. Subsequent tensile tests were conducted on seven types of NLO uranium containing various levels of iron, aluminum, and silicon. Special attention was devoted to the mode of fracture exhibited by the various materials and to the existence of grain-boundary phases and intergranular fracture. No evidence was noted of grain-boundary failure at temperatures up to 450° C. Most failures were precipitated by secondary phases not associated with the grain boundaries. No definite connection was noted between the chemical composition and the tensile properties of the materials that could be related to their irradiation stability. A supplementary study concerned with the substructure and fine-particle distribution in cast uranium was also undertaken. Author

N64-17303 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Tapco Div.
FRACTURE CHARACTERISTICS OF STRUCTURAL METALS Final Summary Technical Report, 1 Jul. 1962-1 Jul. 1963
G. L. Hanna and E. A. Steigerwald 30 Jun. 1963 117 p refs
(Contract N600(19)-58831)
(ER-5426; AD-411509)

An experimental program was conducted to determine the plane-strain fracture toughness (K_{IC}) of the following high-strength materials: 4340 steel (two strength levels); H-11 steel (four strength levels); maraging steel (two strength levels); and beta titanium (one strength level). The K_{IC} parameter was determined from circumferentially precracked round specimens and from resistance measurements conducted on precracked sheet specimens. Several heats of each material were evaluated over temperatures ranging from −100° to 300° F. The experimentally determined data were combined with results of plane-strain fracture toughness presented in the literature to produce typical room-temperature K_{IC} values for 4340 and H-11 sheet that could be considered for inclusion in MIL Handbook 5. Author

N64-17317 Rock Island Arsenal Lab., Ill.
CONTROL OF STRESS CORROSION Interim Report
R. H. Wolff 26 Nov. 1963 13 p refs
(RIA-63-3890; AD-432320) OTS: $0.50

This study of the control of stress corrosion cracking susceptibility of steels by application of protective coatings was designed to use abrasive blasted specimens to simulate more nearly the surfaces and conditions of a manufacturing operation. Initial work was conducted using specimens of aircraft-quality 4130 alloy sheet steel, heat treated to 200,000 psi yield strength. Zinc was chosen as protective coating and was applied to abrasive blasted bent-beam specimens in three forms: by zinc electroplating, zinc phosphatizing, and by zinc dust dispersion. Coated bent-beam specimens, tensile loaded at 75% of yield strength were placed in high humidity and in semi-industrial outdoor exposure. Control specimens in "as heat treated" condition have failed in both atmospheres. Tests are continuing. Author

N64-17356 Wah Chang Corp., Albany, Ore.
REDUCTION AND CONSOLIDATION OF SUPERIOR QUALITY MOLYBDENUM ALLOYS Final Report [3 Mar. 1960-31 Dec. 1963]
Chun T. Wang 31 Dec. 1963 123 p refs
(Contract NOAS-60-6046-C)
(WCA-1001-9; AD-430913) OTS: $10.10

Various efforts to produce superior quality molybdenum have been conducted. Calcium reduction of molybdenum in 14-inch bombs produced reguli weighing 50 to 100 pounds. The total interstitial level was approximately 500 parts per million. To attain satisfactory melting of calcium-reduced reguli, it was necessary to modify the electron beam furnace by relocating the electron gun and inserting accelerating anodes. Inert atmosphere handling and vacuum sintering of hydrogen-reduced molybdenum powder was employed. The interstitial elements of the powder metallurgical product were near the minimum detection level. Single crystals obtained from fractured electron beam melted ingots were fabricated to rod and sheet and tensile tested. Tensile strengths were similar to those of polycrystalline electron beam melted materials. Studies of the refinement of grain size of electron beam melted ingots by additions of boron and silicon were conducted. The boron addition showed definite grain refining effects, whereas silicon was not effective. Author

N64-17359 Aerospace Corp., El Segundo, Calif. Labs. Div.
ON THE MECHANISM OF STRENGTHENING IN MARAGING STEELS
H. Conrad 21 Feb. 1964 8 p refs
(Contract AF 04(695)-269)
(TDR-269(4240-10)-10; SSD-TDR-64-13; AD-432842)

To determine whether strengthening in maraging steels was associated with the thermal or athermal component of the stress, calculations were made from data by Bush (1963). Indications were that the principal strengthening mechanism is athermal in nature, and is due to the presence of long-range internal stresses, associated with a fine dispersion of precipitate particles. Author

N64-17372 Arde-Portland, Inc., Paramus, N.J.
DEVELOPMENT OF HIGH-STRENGTH ALLOYS BY CRYOGENIC STRETCH-FORMING Quarterly Technical Report No. 3, 10 Oct. 1963-9 Jan. 1964
Martin S. Miller [1964] 21 p refs
(Contract NOw-63-0387-C)
(AD-431651)

Twelve heats have been procured and tested. Four additional cobalt–molybdenum-modified heats are under test. High-age-response heat, RV 1252, presented no problems in welding. However, notch tests (NASA notch) on this material revealed a high notch sensitivity at room temperature. A second columbium–aluminum heat, RV 1336, showed improved notch strength (due mainly to a lower carbon content). Additional heats tested strengthen the conclusion, advanced previously, that unmodified vacuum-melted 301 stainless steel has negligible strength increase after an aging treatment. Specific alloys must be added to develop an aging system in the steel. The columbium–aluminum system does this effectively, but it renders the material notch sensitive. Several air-melted heats tested confirmed the reliability of the computer analysis in predicting tensile strength. Deviations between predicted and measured room-temperature tensile strengths ranged from 2 to 10 ksi. Author

N64-17373 Naval Research Lab., Washington, D.C. Strength of Metals Branch

CRACK TOUGHNESS OF TWO HIGH-STRENGTH SHEET STEELS

J. E. Srawley, T. C. Lupton, and W. S. Kenton, Sr. 13 Feb. 1963 13 p refs

(NRL 5895; AD-298177) OTS: $0.50

Surface-cracked sheet specimens of a high-strength proprietary steel (AH) and a 0.52% carbon modification of AMS 6434 steel (P-12) were heat treated to various yield strengths in the range 200,000 to 270,000 psi and tested to determine K_{Ic} plane-strain crack toughness values. The K_{Ic} toughness of carbon-modified AMS 6434 was somewhat higher than that of AMS 6434 of normal carbon content at a yield strength of 225,000 psi. In the yield strength range 220,000 to 243,000 psi, the K_{Ic} toughness of P-12 was considerably higher than that of AH. In addition to the results obtained at room temperature for both steels, tests on P-12 were also conducted at temperatures down to −295° F at two strength levels. Fracture mode transitions from oblique to transverse occurred in this range of temperature, but these were not accompanied by abrupt changes in K_{Ic}. Author

N64-17477 IIT Research Inst., Chicago, Ill.

HIGH-TEMPERATURE OXIDATION PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS Bimonthly Report, 1 Dec. 1963-31 Jan. 1964

F. C. Holtz et al 28 Feb. 1964 11 p refs

(Contract NOw-64-0140-C)

(IITRI-B6019-2; AD-431776)

The influence of the pack-siliconizing coating and the coating process on the mechanical properties of V-60 w/o Cb-1 w/o Ti is under investigation. Preliminary results show that no hardening of the substrate of 0.050 in. coated sheet occurs after twenty-five 4-hr static air oxidation cycles at 2,000° F. The pack siliconizing process has been modified to eliminate potential sources on interstitial contamination of the alloys during the coating process. Results indicate that the coated materials produced under these conditions in all cases have a ductile-to-brittle transition temperature below room temperature. Work has also been initiated in the development of an oxidation-resistant slurry or liquid-cementation-type coating for vanadium–columbium alloys. Author

N64-17496 Bureau of Mines, Rolla, Mo. Rolla Metallurgy Research Center

URANIUM ALLOYED STEELS; THEIR FABRICATION AND MECHANICAL PROPERTIES

L. W. Higley, Jr., and K. A. Fowler [1964] 20 p refs

(Sponsored by AEC)

(BM-RI-6403)

Steels with an alloying addition of depleted uranium were studied to develop successful melting, casting, and fabricating methods; to obtain data on mechanical properties; and to determine the effects of this alloying element. Uranium in amounts up to 1.5% was added to steel-base compositions containing approximately 1.5% carbon, 2% nickel, 0.25 to 2.0% silicon, and 0.75% manganese in both vacuum-melted and air-melted heats. Radiation levels were monitored for all operations. Research showed that uranium additions did not increase tensile strength; that hot-shortness occurred during forging above 1,090° C because of the presence of a low melting point constituent of a eutectic type; and, although a measurable amount of radioactive contamination resulted from processing, the quantity was never large enough to require the work area to be identified as a radiation area. Author

N64-17503 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.

METALLURGY RESEARCH OPERATION, OCTOBER, NOVEMBER, DECEMBER, 1963 Quarterly Progress Report

J. J. Cadwell, J. C. Tobin, T. K. Bierlein, R. L. Dillon, and R. G. Wheeler 15 Jan. 1964 192 p refs

(Contract AT(45-1)-1350)

(HW-79766) OTS: $2.75

The following topics are discussed: (1) physical metallurgy—neutron damage to metals, swelling of irradiated fissionable materials, and plutonium physical metallurgy, (2) reactor metals research—alloy selection, in-reactor measurements of mechanical properties, irradiation effects, and damage mechanism, (3) chemical metallurgy, and (4) materials engineering—gas loop development, plutonium recycle test reactor (PRTR) pressure tubes, and N-reactor pressure tubes. R.T.K.

N64-17513 Massachusetts Inst. of Tech., Cambridge Surface Lab.

FRICTION AND WEAR AT ELEVATED TEMPERATURES

Ernest Rabinowicz, Masaya Imai, and Victor Santos Wright-Patterson AFB, Ohio, Res. and Technol. Div., Dec. 1963 37 p refs

(Contract AF 33(616)-7648)

(RTD-TDR-63-4272, Pt. 5; AD-431818)

Friction measurements have been carried out of the friction coefficient as a function of temperature, using solid surfaces covered by various solid films. The films included a soft metal (lead) and two hard metals (nickel and chromium) applied in various thicknesses, oxide coatings produced naturally by high-temperature oxidation of Hastelloy alloys, and a silver coating produced continuously by electrodeposition during sliding. The effectiveness of these coatings depends in a rather complex way on their thickness, their adhesion, and the difference in strength between them and their substrates. Author

N64-17515 Solar, San Diego, Calif.

EVALUATION OF COATED REFRACTORY METAL FOILS Technical Documentary Report, 1 Jul. 1962-30 Jun. 1963

V. S. Moore and A. R. Stetson Wright-Patterson AFB, Ohio AF Mater. Lab., Sep. 1963 353 p refs

(Contract AF 33(657)-9443)

(RTD-TDR-63-4006, Pt. 1; AD-427764)

An extensive evaluation program was carried out to determine the capabilities of nine commercial coating vendors to coat effectively columbium and molybdenum alloy foils (0.006 inch). Two columbium-based alloys (D36-Cb-10Ti-5Zr; B66-Cb-5Mo-5V-1Zr) and one molybdenum based alloy (TZM-Mo-0.5Ti-0.08Zr-0.02C) were included. Tests performed in the program were receiving inspection (metallography, weight change, gross effects, and microhardness), mechanical properties at room temperature, bend ductility, ductile–brittle transition temperature, cyclic oxidation resistance in a furnace with and without prestraining and in a plasma-torch flame at 5 and 760 torr, diffusion rates, creep, and fatigue life. Interaction of coating and joining processes was studied on D36 and B66 alloys. Fusion and resistance welding, diffusion bonding, and brazing were investigated. Fusion welding is the most readily protected with braze alloys being second. A development program on the Cr-Ti-Si coating resulted in an improved process that reduced diffusion into the substrate, minimizing ductility loss after high-temperature exposure.

Author

N64-17524 Thompson Ramo Wooldridge, Inc., Cleveland, Ohio
INFLUENCE OF ENVIRONMENT ON CRACK PROPAGATION AND DELAYED FAILURES IN HIGH-STRENGTH STEELS Technical Documentary Report, Dec. 1962-Nov. 1963
G. L. Hanna and E. A. Steigerwald Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1964 52 p refs
(Contract AF 33(657)-7512)
(RTD-TDR-63-4225; AD-433286)

Environmentally induced crack propagation was studied in several classes of high-strength steels with particular emphasis on the influence of aqueous media. Low-alloy martensitic steels, 4340 and 300M, were very susceptible to delayed failure in a water or moist air environment, and an H-11 die steel was only moderately embrittled. Under the particular test conditions employed, the precipitation-hardening and maraging steels were relatively unaffected by aqueous environments. Constant load, stress rupture tests on precracked specimens of 4340 and 300M steel indicated that less than 1 grain of water per cubic foot of gas could induce delayed failure. The effects of test temperature, notch sensitivity, degree of water aeration, cathodic polarization, and applied stress were studied with the specific purpose of defining the mechanism that governed the embrittlement. The results, particularly the reversibility of the incubation time required to initiate slow crack growth, indicated that hydrogen produced by the corrosion process was the primary cause of the embrittlement. Author

N64-17566* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
SNAP-8 MATERIALS
C. M. Scheuermann, C. A. Barrett, W. H. Lowdermilk, and Louis Rosenblum Repr. from Astronautics and Aerospace Eng., Dec. 1963 p 40-43 refs
(NASA RP-148)

This paper describes some of the preliminary results of the Snap-8 materials screening program. Twenty-four materials were chosen for this program from the following categories: (1) austenitic stainless steels; (2) semiaustenitic stainless steels; (3) martensitic chromium steels, including 400-series stainless steels; (4) cobalt-base alloys; (5) refractory metals and alloys; and (6) nickel-base alloys. Of all the materials tested, tantalum and columbium-1% zirconium alloy were the most corrosion resistant. The martensitic and low-alloy steels were next best in corrosion resistance. The corrosive attack of a material by mercury was found to be directly related to the total percentage of mercury-soluble elements present in these materials. R.T.K.

N64-17648 New England Materials Lab., Inc., Medford, Mass.
HIGH TEMPERATURE DEFORMATION AND FRACTURE BEHAVIOR OF METALS UNDER HIGH STRAIN RATE CONDITIONS Progress Report No. 4, 1 Nov. 1963-1 Jan. 1964
J. M. Dhosi, R. Widmer, and N. J. Grant Jan. 1964 13 p
(Contract NOw-63-0502-c)
(AD-432669)

Work was continued on the evaluation of the high-strain-rate deformation behavior of cast Udimet 700, hot-pressed beryllium, and arc melted tungsten over a wide range of temperatures and rates of deformation. The program is aimed primarily at the determination of optimum hot working parameters of hard-to-work materials. The results indicate that this can be achieved by testing the ingot material at various stresses, strain rates, and temperatures, as well as by taking samples from critical areas and various specimen axes of the piece to be forged. Author

N64-17673 Battelle Memorial Inst., Columbus, Ohio
DEVELOPMENT OF ALUMINUM CASTINGS WITH HIGH IMPACT STRENGTH AT LOW TEMPERATURES Summary Report, 26 Jun. 1962-26 Jun. 1963
D. N. Williams, R. A. Wood, and H. R. Ogden 26 Jun. 1963 84 p refs
(NASA Contract NAS8-1689)
(NASA CR-55908) OTS: $8.10 ph, $2.72 mf

A study of the effects of alloy composition on the properties of high-purity Al-Cu casting alloys has shown that it is possible to prepare castings with a yield strength at room temperature of 40 to 45 ksi and Charpy impact properties at -420° F of 15 ft-lb or more. Strength is obtained primarily through the addition of a small amount of cadmium. The best alloy composition developed during this program was 4.5Cu-0.1Cd-0.1Mg-0.05Ti. A reasonably complex sand casting was made from this alloy without undue difficulty. The alloy must be heat treated to the T6 temper to develop optimum properties. Castings of this alloy can be joined by welding, using 2319 weld wire, but weldments do not develop strengths equivalent to that of the base alloy. Author

N64-17691* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
A LITERATURE SURVEY OF THE CORROSION OF METAL ALLOYS IN LIQUID AND GASEOUS FLUORINE
J. H. Cabaniss and J. G. Williamson 31 Dec. 1963 31 p refs
(NASA TM X-54612; MTP-P&VE-M-63-21) OTS: $3.60 ph, $1.13 mf

A literature survey on the corrosive nature of both liquid and gaseous fluorine is presented. This paper contains general information regarding: (1) chemical reaction of fluorine with various metallic materials; (2) conditions under which these materials can be used with fluorine; (3) results of corrosion tests that have been conducted on various materials over the temperature range of -320° F (-196° C) to 1,300° F (704° C). Author

N64-17736 Joint Publications Research Service, Washington, D.C.
APPLYING COATINGS ON TITANIUM AND TITANIUM PLATING
N. D. Tomashov and R. M. Al'tovskiy 27 Mar. 1964 11 p Transl. into ENGLISH from the book "Korroziya i Zashchita Titana" Moscow, 1963 p 147-153
(JPRS-23913; OTS-64-21920) OTS: $0.50

The following methods for strengthening the surface of titanium are discussed: nitration, oxidation, and application of wear-resistant metal coverings. R.T.K.

N64-17737 Army Materials Research Agency, Watertown, Mass.
COMPARISON OF VARIOUS TEST SPECIMENS FOR THE DETERMINATION OF NOTCH SENSITIVITY AND FRACTURE TOUGHNESS OF HIGH STRENGTH SHEET MATERIALS
Charles F. Hickey, Jr., and Frank R. Larson [1962] 33 p refs Presented at the 66th Ann. Meeting of the Am. Soc. for Testing and Mater., Atlantic City, 23-28 Jun. 1962.
(AD-432871)

The purpose of this program was to compare various test specimens for the determination of notch sensitivity and fracture toughness. Specimens considered are as follows: (1) 1-in.-wide edge notch, (2) 1.5-in.-wide center notch, and (3) 3-in.-wide center notch. Notch sensitivity data were obtained from all specimens, whereas fracture toughness data, based upon the ink stain and percent shear method, were gathered primarily from the 3-in.-wide specimen. Materials considered include AMS 6434, H-11, 300M, and PH7-15Mo steels and 6Al-4V titanium. Two or more strength levels per alloy were investigated, and testing temperatures ranged from +165° to −80° F. Results of this investigation indicate that, of the designs considered, the 3-in.-wide specimen generally offers the best test to measure notch sensitivity or fracture toughness. Author

N64-17755 Los Alamos Scientific Lab., N. Mex.
SOLID PLUTONIUM FUELS PROGRAM Quarterly Status Report, 1 Oct.-31 Dec. 1963
J. A. Leary, W. J. Maraman, W. N. Miner, and F. W. Schonfeld
20 Mar. 1964 15 p refs
(Contract W-7405-ENG-36)
(LAMS-3054) OTS: $0.50

Solid plutonium fuels are reviewed. The preparation of plutonium oxides and nitrides is discussed. The results of thermal-conductivity studies of UC, $(U_{0.9}Pu_{0.1})C$, $(U_{0.8}Pu_{0.2})C$, $(U_{0.7}Pu_{0.3})C$, and single phase $PuC_{0.87}$ were plotted. The electrical resistivities of $(U_{0.8}Pu_{0.2})C$, $PuC_{0.87}$, and $PuC_{1.0}$ were measured in the temperature range of 25° to 800° C. The thermodynamic properties of $PuFe_2$ and (Pu-Fe) solutions are being determined by means of 3 types of galvanic cells. Efforts aimed toward delineating the phase fields in the Pu-C-O ternary phase diagram continued. Analytical results, obtained for a number of the ternary alloys, showed that some of these alloys, most of which contained between 45 and 55 w/o Pu and had various carbon-to-oxygen ratios, gained oxygen during vacuum heat treatment at 1,400° C. These analytical data, when combined with X-ray and metallographic information now available, appear to be sufficiently accurate to allow locating phase boundaries in the ternary diagram with a precision of about ±3%. I.v.L.

N64-17781 Aerospace Corp., El Segundo, Calif.
CREEP OF NIOBIUM AT LOW TEMPERATURES. GENERAL RESEARCH
G. A. Stone and H. Conrad 21 Feb. 1964 25 p refs
(ATN-64(9236)-9; AD-433492)

The activation energy, H, the activation volume, v*, and the frequency factor, ν, for the plastic deformation of niobium at low temperatures ($T<0.2T_m$) were derived from creep tests. The values of H and v* for $\tau^* = 1$ kg/mm^2 were 0.75 ev and 47b^3, respectively, decreasing with increase in stress. The value of ν was 2×10^8 sec^{-1}. These values are in excellent agreement with those derived from constant strain rate tests, indicating an equivalence between the two types of testing. The present results support the idea that overcoming the Peierls–Nabarro stress is the rate-controlling mechanism during the plastic deformation of the bcc metals at low temperatures. Using the models of Seeger and of Dorn and Rajnak, the kink energy in niobium is calculated to be 0.34 to 0.40 ev. Author

N64-17800 British Welding Research Assn., Cambridge Research Station
INFLUENCE OF ALLOYING ELEMENTS ON THE CONTINUOUS COOLING TRANSFORMATION AND WELDABILITY OF BINARY AND TERNARY ALLOYS OF IRON Final Technical Report, 1 Dec. 1962-28 Feb. 1963
F. Watkinson and R. G. Baker, May 1963 62 p refs
(Contract DA-91-591-EUC-2250; Contract BWRA-C59)
(C59/12/63; B2/WSS/46/63; AD-434008) OTS: $6.60

Dilatometric, metallographic, and hardness studies have been used in determining the continuous cooling transformation behavior of a wide range of binary, ternary, and quaternary alloys of iron. Welding tests have been made on these alloys, and a general correlation of heat-affected zone cracking with hardness and microstructure in the heat-affected zone has been obtained. The results can be used in establishing a rational approach to the problem of devising satisfactory welding procedures for different compositions. It is shown that alloys may be classified in five main groups, the approach to welding them depending on hardenability and microstructural type within each group. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-16918* Rensselaer Polytechnic Inst., Troy, N.Y. Interdisciplinary Materials Research Center
CELLULOSE-FIBER BONDING
A. H. Nissan and S. S. Sternstein Repr. from Tappi, v. 47, no. 1, Jan. 1964 p 1–6 refs Presented at the Am. Chem. Soc. Meeting, Atlantic City, Sep. 1962
(NASA Grant NsG-100-60)

The hydrogen bond appears to be the predominant factor both in interfiber and in intrafiber bonding. The number of these bonds that resist an infinitesimal mechanical strain, namely, n_E, is proportional to the number of hydrogen bonds that are taking part in the straining process immediately preceding rupture, namely, $n_{R\cdot E}$. Also, the number of hydrogen bonds that are active in resisting mechanical strains is a fraction of the stoichiometric (possible) number of hydrogen bonds, n_T. For cellulose-fiber sheets, the effective fraction of hydrogen bonds that resists mechanical strain is given by $(n_E/n_T) = (\rho/1.6)^5$, where ρ is the apparent density of the sheet. The elastic modulus, E, of the sheet is related to the effective number of hydrogen bonds by the empirical relationship $E = 7600\, n_E^{1/3}$. Author

N64-16965 Princeton U., N.J. Frick Chemical Lab.
MEASUREMENT OF RANDOM SCISSION BY STRESS RELAXATION
Arthur V. Tobolsky Feb. 1964 8 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-71; AD-431272)

A network of relatively uniform chain length was postulated. Experimental evidence is presented in order to substantiate this theory. A series of tetrasulfide rubber networks were made by reacting various mixtures of ethylene dichloride, 1,2,3 trichloropropane, and sodium tetrasulfide. The concentration of network chains per cc and the average number $\bar{m}$ of tetrasulfide linkages between junctures were known for these networks. Stress relaxation measurements were made on these networks. Formulas (rate equations) derived for uniform networks fitted the experimental data extremely well. R.T.K.

N64-16986 Forest Products Lab., Madison, Wis.
FATIGUE STRENGTH OF PHENOLIC LAMINATES FROM 1 TO 10 MILLION CYCLES OF REPEATED LOAD
G. H. Stevens Jan. 1964 29 p refs
(Contract AF 33(657)63-358; BuWeps Order 19-64-8004)
(FPL-027; AD-432302)

This report presents fatigue strength of phenolic laminates 1/4, 1/8, and 1/16 in. in thickness under repeated load. Laminates were of CTL-91LD phenolic resin reinforced with 181-A1100 glass fabric. Fatigue strength values were determined by applying axial loads parallel to the warp direction of the glass fabric reinforcement at 5, 25, and 900 cycles per minute and at mean stress levels of zero pounds per square inch, 25 and 50 percent of the compression control strength, and at 50 percent of the tension control strength. Specimens were evaluated at 73°, 400°, 500°, 600°, and 800° F. Results are presented in tables and in S-N curves (maximum applied stress versus number of cycles to failure). Author

N64-16993 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
INVESTIGATION OF BONDING IN OXIDE-FIBER (WHISKER) REINFORCED METALS Fifth Quarterly Report, 1 Jul.-30 Sep. 1963
Willard H. Sutton Sep. 1963 34 p refs
(Contract DA-36-034-ORD-3768Z)
(AMRA-CR-63-01/5; AD-427056)

Special binary alloys of pure nickel containing one atomic percent of Al, Cu, In, Ti, Zr and Cr were prepared and were used in sessile drop experiments, which were conducted at temperatures ranging between 1,460° C and 1,510° C and at pressures of 5×10^{-5} torr. It was found that the additions of Al, Cu, and In had little effect in lowering the contact angle between pure Ni and single crystal substrates of $\alpha - Al_2O_3$. However, the Ti, Zr, and Cr additions, which reacted chemically with the substrate, lowered the contact angle significantly. Future studies are planned that will study the effect of interfacial reactions on the bond strength between the Ni-Ni alloys and $\alpha - Al_2O_3$. Author

N64-17073 California U., Livermore Lawrence Radiation Lab.
SOME KINETIC AND THERMODYNAMIC PROPERTIES OF THE REFRACTORY METAL BORIDES AND NITRIDES. AN ANNOTATED BIBLIOGRAPHY
M. Temple Milliken and Jean E. Senkin, comp. Sep. 1963 348 p refs
(Contract W-7405-ENG-48)
(UCRL-7559) OTS: $4.50

The references in this bibliography refer to the literature concerning the kinetic, mechanical, and thermodynamic properties of the borides and nitrides of Al, Si, Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, and W. This compilation is a complement to a bibliography on the properties of the refractory carbides. Author

N64-17129 McDonnell Aircraft Corp., St. Louis, Mo.
EVALUATION OF WELDMENTS FABRICATED FROM MATERIAL PRECOATED WITH MACCO 306 RUST PREVENTATIVE
John R. Huelner 10 Mar. 1964 40 p
(Contract AF 33(657)-11215)
(A462; AD-431619)

MACCO 306 is a new rust preventative for ferrous metals that does not require removal prior to welding operations. This test was conducted to determine the effect on the fusion and resistance weldability of ferrous metals coated with MACCO 306 prior to welding. Room temperature tensile tests and bend tests were conducted on specimens removed from coated and uncoated 0.250-in. fusion welded NAX (MMS201) steel panels. Room-temperature lap shear tests and metallographic examinations were conducted on coated and uncoated single spot resistance welded 0.050 to 0.050-in. NAX lap shear specimens. A 14-day, 90-percent humidity test was conducted on coated and uncoated fusion-welded and resistance-welded specimens. MACCO 306 was found to be a good corrosion inhibitor. Welding through the MACCO 306 coating did not produce any detrimental effect on the mechanical properties or metallurgical quality of the welds. Author

N64-17141 McDonnell Aircraft Corp., St. Louis, Mo.
DETERMINATION OF THE ENERGY ABSORPTION CHARACTERISTICS OF VARIOUS LOW DENSITY FOAM TYPE PLASTICS
J. Swafford 10 Mar. 1964 27 p
(Contract AF 33(657)-11215)
(A483; AD-431513)

Based on the results of this test program, aluminum honeycomb appears to present the best absorption characteristics of the low-density-type materials tested. Author

N64-17143 McDonnell Aircraft Corp., St. Louis, Mo.
INVESTIGATION OF MECHANICAL PROPERTIES OF FOAM-IN-PLACE SANDWICH AT ELEVATED TEMPERATURES Final Report
D. W. Johnson 10 Mar. 1964 15 p
(Contract AF 33(657)-11215)
(A485; AD-431515)

Tests were conducted to evaluate the compressive strength of sandwich panels at room and elevated temperatures. The test specimens, all with Eccofoam FPH core material, were prepared with epoxy fiberglass laminate, AMS 4901 titanium, and 2024-T81 aluminum alloy face skins. The decrease of failing face skin compressive stress sustained by the specimens as the test temperature was increased above room temperature, and the tendency of the core material to char and partially melt at 400° F and above, indicate the Eccofoam FPH is not a satisfactory core material for high-temperature aircraft structure. Author

N64-17144 McDonnell Aircraft Corp., St. Louis, Mo.
EVALUATION OF EC-766 SR AT TEMPERATURES BELOW ROOM TEMPERATURE Final Report
J. Swafford 10 Mar. 1964 7 p
(Contract AF 33(657)-11215)
(A486; AD-431516)

This test was conducted to determine: (1) the viscosity of EC-776SR at 50°, 60°, 70°, and 77° F; and (2) the effect of viscosity variation as caused by temperature on the film thickness of EC776SR dip applied to aluminum panels. The viscosity of EC776SR varied from 304 to 480 CPS, and the total film thickness varied from 0.001 to 0.002 in., resulting in an average film weight change of approximately 30%. Author

N64-17146 McDonnell Aircraft Corp., St. Louis, Mo.
EVALUATION OF SUPER KOROPON AIRCRAFT PRIMER SURFACER Final Report
William Riatt 10 Mar. 1964 4 p
(Contract AF 33(657)-11215)
(A-488; AD-431517)

This test was initiated to determine if Super Koropon Primer Surfacer can be overcoated with MMS-405 Epoxy Enamel, and to establish the approximate drying time that will permit sanding to a smooth finish. Two 5 × 7 × 0.125-in. MMS-501 Class B polyester panels were sanded, cleaned with xylene, and allowed to dry for 1 hour. Two coats of the Primer Surfacer were applied, approximately 0.003-in. thick, allowing 30 minutes for drying between coats. The panels could be sanded in 1 hour. After sanding the primer to a smooth finish, two more coats were applied. The primer was dried, cured, and sanded in 90 minutes. One panel was subjected to the dry tape test and soaked in a preheated oven at 300° F for 30 minutes. The panel was tape tested again at room temperature. The other panel was coated with MMS-405 White Epoxy per McDonnell PS 13415. After a 24-hour cure, the panel was soaked in water for 24 hours and tested for wet tape adhesion per Method 6301 of Federal Test Method Standard No. 141. There was no damage to any panel by the wet or dry tape tests, nor any film degradation due to exposure to 300° F. Author

N64-17147 McDonnell Aircraft Corp., St. Louis, Mo.
EFFECT OF CERAMIC COATINGS ON 321 STAINLESS STEEL
S. J. Krieg 10 Mar. 1964 7 p
(Contract AF 33(657)-11215)
(A-489; AD-431864)

An investigation was conducted to determine if lead sulfide-boric oxide and lead monoxide-silica coatings caused any deleterious effects to metal substrates in the temperature 1,200° to 1,400° F. Pairs of stainless steel panels having these coatings were exposed to 1,200°, 1,300°, and 1,400° F. After 6 hours exposure at 1,200° and 1,300° F both the lead sulfide–boric oxide and the lead monoxide–silica coated specimens showed no deleterious effects at the coating substrate interface. After 6 hours' exposure at 1,400° F the lead sulfide–boric oxide and the lead monoxide–silica-coated specimens showed a slight intergranular attack on the stainless steel substrate. C.L.W.

N64-17221 Hanford Atomic Products Operation, Richland, Washington
CERAMICS RESEARCH AND DEVELOPMENT OPERATION Quarterly Report, Jul.-Sep. 1963
D. F. Carroll et al 27 Jan. 1964 125 p refs
(Contract AT(45-1)-1350)
(HW-76303) OTS: $2.50

Papers are presented on the following subjects: (1) ceramics research; (2) fuels development; and (3) fuels testing and analysis. R.T.K.

N64-17231 Joint Publications Research Service, Washington, D.C.
CERAMICS FOR AVIATION PARTS
I. D. Abramson 16 Mar. 1964 283 p refs Transl. into ENGLISH of the book "Keramika dlya Aviatsionnykh Izdeliy" Moscow, Oborongiz, 1963 240 p
(JPRS-23706; OTS-64-21802) OTS: $4.00

This book describes the high-alumina ceramic, synoxal. The physicochemical bases of the technology for preparing objects from synoxal, in particular, insulators for aviation spark plugs, as well as ceramic rods and shapes for accurate casting of the turbine vanes of jet engines, are presented. Author

N64-17263 California U., Berkeley Lawrence Radiation Lab.
VAPOR PRESSURE AND HEAT OF SUBLIMATION OF BARIUM FLUORIDE
Patrick E. Hart (M.S. Thesis) 16 Jan. 1964 23 p refs
(Contract W-7405-ENG-48)
(UCRL-11124) OTS: $0.50

The vapor pressure of barium fluoride was measured in the temperature range 1261° to 1548° K by the torsion–effusion method. The vapor pressure of barium fluoride in atmospheres is given by the expression $\log P = -(78.70/45.76 \pm 1.42) \times 10^4/T + 6.94 \pm 0.23$ where the quoted errors are the standard deviation from the least-squares fit. Extrapolation of the data yields a heat of sublimation at 298° K of 90.29 ±2 kcal/mole by the third-law method and 87.06 ±1.45 kcal/mole by the second-law method. Author

N64-17314 Princeton U., N.J. Frick Chemical Lab.
A MOLECULAR THEORY FOR VISCOELASTIC BEHAVIOR OF AMORPHOUS POLYMERS
A. V. Tobolsky and J. J. Aklonis Feb. 1964 13 p refs
(Contract Nonr-1858(07))
(AD-431939)

The relaxation modulus for N.B.S. polyisobutylene has been interpreted as a sum of two Rouse functions each arising from a different molecular mechanism. One is associated with torsional vibrations and internal rotation. The other is associated with an entangled network of gaussian segments. Each Rouse function is characterized by three parameters, which can be obtained from the experimental relaxation modulus. Author

N64-17327 General Electric Co., Philadelphia, Pa. Missile and Space Div.
INVESTIGATION OF TOXIC PROPERTIES OF MATERIALS USED IN SPACE VEHICLES Final Report, Mar. 1962-Jan. 1963
W. J. Olewinski, G. Rapier, T. K. Slawecki, and H. Warner Wright-Patterson AFB, Ohio, Biomedical Lab., Dec. 1963 162 p refs
(Contract AF 33(657)-8029)
(63SD795; AMRL-TDR-63-99; AD-431149) OTS: $3.00

The objectives of this program were: (1) to compile lists of materials presently used or proposed for use in spacecraft—specifically, the Apollo, Mercury, Gemini, and Dyna-Soar programs—and to assess the possible toxic properties and breakdown products of these materials under thermal and other anticipated stresses; and (2) to evaluate methods for the detection and identification of space-cabin contaminants for the purpose of compiling the requirements, methods, and specifications on available instrumentation. These in turn can serve as the basis for development of a compact kit for detection of toxic off-gassing from materials employed in space vehicles. For other than short duration missions, monitoring instrumentation must be capable of the detection and identification of a wide variety of toxic contaminants, some of which may not have been anticipated. A highly sensitive multiple gas detector, either directly or in combination with a trace gas separation and concentration technique, appears to be a desirable approach. Many of the comments on gases and vapors also apply to particulate contaminants. Author

N64-17465 Joint Publications Research Service, Washington, D.C.
PHYSICOCHEMICAL PROPERTIES OF GLASS FIBER
A. F. Zak 9 May 1963 288 p refs Transl. into ENGLISH of the book "Fiziko-Khimicheskiye Svoystva Steklyannogo Volokna" Moscow, 1962 p 1–224
(JPRS-19122; OTS-63-21793) OTS: $4.00

This book gives concise information on the existing methods of producing glass fiber for various purposes. The most important properties of glass fiber and the objects produced from it, and the dependence of these properties on factors of various natures are presented in detail. The existing theories on the structure of glass fiber are critically discussed. Author

N64-17494* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

DEGRADATION OF HOMOGENEOUS POLYMERIC MATERIALS EXPOSED TO HIGH HEAT FLUXES

Robert G. Nagler 1 Feb. 1964 30 p refs

(NASA Contract NAS7-100)

(NASA CR-53256; JPL-TR-32-527) OTS: $2.60 ph, $1.10 mf

An arc imaging furnace was used to expose polymeric materials to a variety of heating rates under static or near-static flow conditions and under reduced pressures. Data obtained on polymethylmethacrylate, polytetrafluoroethylene, and polyethylene show a linear relationship between heat input and surface recession that is not inconsistent with theory. Comprehensive measurements of polymer reflectivities and transmissivities are necessary before a detailed analysis of the data would be meaningful. The degradation products collected in this investigation do not agree with those previously reported for these polymers at similar temperatures and heating rates.

Author

N64-17520 ARO, Inc., Arnold Air Force Station, Tenn.

CRYOPUMPING OF NITROUS OXIDE

R. F. Brown Arnold Eng. Develop. Center, Feb. 1964 28 p refs

(Contract AF 40(600)-1000)

(AEDC-TDR-63-267; AD-431229)

An experimental study of the pumping speed of N_2O at 77° K is presented. It is shown that the pumping speed remains constant in the free-molecular flow region, increases in the lower transition region, and then declines very rapidly as the pressure is further increased. The rapid decline in pumping speed in the higher pressure region is caused by the combined effects of the noncondensable gas present in the system and thermal overloading of the cryosurface. However, the exact contribution of each has not been determined. Author

N64-17532 Atomic Energy Commission, Washington, D.C. Div. of Tech. Information

THE FOURTH URANIUM CARBIDE CONFERENCE, EAST HARTFORD, CONNECTICUT, MAY 20-21, 1963

G. D. White et al Feb. 1964 221 p refs

(Sponsored by AEC)

(TID-7676) OTS: $3.00

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17. THERMAL DECOMPOSITION OF URANIUM CARBIDE, PRATT AND WHITNEY AIRCRAFT DIVISION P. A. Vozzella, A. D. Miller, and M. A. De Crescente (Pratt and Whitney Aircraft) p 154-162

18. STUDIES OF ALLOY CARBIDES AT WESTINGHOUSE ASTRONUCLEAR LABORATORY A. Boltax, C. E. Vogel, and W. D. Allen (Westinghouse Astronuclear Lab.) p 163-169

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20. CARBIDE FUEL DEVELOPMENT AT THE UNITED NUCLEAR CORPORATION D. Stahl and A. Strasser (United Nucl. Corp.) p 183-198

21. PROGRESS IN PROPERTY DETERMINATIONS AND FABRICATION OF URANIUM CARBIDE AT UNITED NUCLEAR CORPORATION J. Crane and E. Gordon (United Nucl. Corp.) p 199-213 refs

N64-17588* American Machine and Foundry Co., Alexandria, Va.

SUPPLEMENTAL INFORMATION ON HIGH TEMPERATURE COATING AND MATERIAL PROGRAMS AT AMF

M. E. Browning, E. A. Schatz, L. C. Mc Candless, and E. G. Pearson [1964] 6 p Suppl. the Rept. to the NASA-ASD Refractory Composites Working Group, Palo Alto, Calif., 11-14 Mar. 1963 (NASA CR-53234; AMF AR63-502A) OTS: $1.10 ph, $0.80 mf

Conventional silicide, aluminide, and beryllide coatings have been studied for emittance properties after various exposures. Borides, chromides, and nitrides were also studied. Early indications are inconclusive, but using titanium systems the chromides and borides have total normal emittances above 0.8 while the silicides and aluminides are slightly below. The emittance of presently available coatings may, in some cases, be improved without deleterious effect to overall protectiveness. AMFkote #2 can be improved to display a total normal emittance near 0.9 at temperatures above 1,000° C. Thin-skin structures may be protected by high-emittance coatings representing families of materials not commonly used for high-temperatures protective coatings. Author

N64-17591* National Beryllia Corp., Haskell, N.J.

RESEARCH ON LOW-DENSITY THERMAL INSULATION MATERIALS FOR USE ABOVE 3000°F Seventh Quarterly Status Report, 1 Oct.-31 Dec. 1963

K. H. Styhr [1964] 23 p refs
(NASA Contract NASr-99)
(NASA CR-53201) OTS: $2.60 ph, $0.89 mf

Research and development on high-temperature thermal insulation materials is described with emphasis on the effect of internal radiation barriers and scattering agents on the thermal conductivity of Zirconia foams. A description is given of the technique for obtaining experimental thermal data at temperatures up to 4,500° F under steady-state conditions. Curves of thermal conductivity versus temperature are presented for ZrO_2 foams containing dispersions of graphite and refractory metal particles and metal-coated ceramic microspheres. Author

N64-17607* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

AGING OF INSTALLED RUBBER AND PLASTIC GASKETS IN SIMULATED FLIGHT HARDWARE

S. L. Burt, J. M. Stuckey and L. M. Thompson 5 Mar. 1962 75 p refs
(NASA TM X-54517; MTP-P&VE-M-62-6) OTS: $7.60, $2.45 mf

A study of the combined effect of time and atmospheric conditions (ambient temperature, humidity, and oxidation) on the functional reliability of selected gasket materials is discussed. Initially, eight types of rubber, three plastics, and four commerical gaskets (metal and rubber o-rings, Flexitallic, and Allpax) were installed as static seals in conventional flange connectors (bolted and Marman types). Dynamic sealing in three types of solenoid-operated valves equipped with rubber o-ring seals was included in the study. Pressurization testing of installed gaskets for leakage rate measurements was run semi-annually. Accelerated ozone aging, air bomb aging, and compression set tests were carried out in the laboratory for determining the relative age resistance of several types of rubber, and these tests provided a means of measuring the progress made in the development of improved age-resistant stocks. Outdoor weathering tests were run parallel with accelerated laboratory testing. Author

N64-17669* National Beryllia Corp., Haskell, N.J.

STUDY OF IMPROVED BERYLLIUM OXIDE MATERIALS FOR MICROELECTRONICS TECHNOLOGY

R. L. Sharkett 15 Nov. 1963 25 p refs
(NASA Contract NASw-685)
(NASA CR-55913) OTS: $2.60 ph, $0.95 mf

Efforts were made toward the development of techniques for the growth of single crystals of beryllium oxide suitable for use in microelectronic applications, and the precise determination of their mechanical, thermal, and dielectric properties. The nucleation and growth of pure, single crystals of BeO (beryllium oxide) were attempted in two different environments. The first of these is by the water-vapor transport method, in which use is made of a pure BeO system with polycrystalline BeO as both the nutrient material and seeding materials. The second technique is by crystallization of BeO from alkali molybdate. Testing was also carried out to determine the anisotropic characteristics of single crystal BeO as evidenced by the orientation sensitivity of the dielectric and thermal-conducting properties. C.L.W.

N64-17703 Hanford Atomic Products Operation, Richland, Wash.

SPECIFICATIONS FOR VIBRATIONALLY COMPACTED, MIXED OXIDE (UO_2-PuO_2), FUEL ELEMENTS FOR THE PRTR (MARK I-L)

17 Mar. 1964 40 p refs
(Contract AT(45-1)-1350)
(HW-79291) OTS: $1.00

Plutonium-containing, mixed oxide, 19-rod cluster fuel elements have been fabricated for the Plutonium Recycle Test Reactor. The particulate, oxide fuel was densified in Zircaloy cladding tubes by vibrational compaction. Some elements contain physical mixtures of UO_2 and PuO_2, whereas others contain high-density impacted particles ("Nupac" process) in which the PuO_2 is dispersed throughout the UO_2. Detailed specifications governing the fabrication of such elements were developed. Author

N64-17715 Bureau of Mines, Norris, Tenn.

PREPARATION AND EVALUATION OF THE DIBORIDES $(Ti, V)B_2$ $(Ti, Cb)B_2$ AND $(Ti, Ta)B_2$

M. E. Tyrrell and J. Koster 1964 21 p refs
(BMRI-6407)

This work was undertaken to determine the feasibility of making mixed diborides of two metals directly from the metal oxides, boron carbide, and carbon. The diborides (Ti, V), B_2, (Ti, Cb)B_2, and (Ti, Ta)B_2 were prepared in a crucible resistance furnace at 2,100° C, and X-ray-diffraction analyses showed each was a homogeneous solid solution containing approximately equal molar contents of the given diborides. The diboride powders were cold-pressed, sintered to 2,300° C, and evaluated for mechanical strength, rate of oxidation, and resistance to molten metals. The diboride (Ti, Ta)B_2 exhibited the best mechanical properties; the diboride (Ti, Cb)B_2, the lowest cumulative rate of oxidation. The mixtures were stable in the presence of molten aluminum and copper but were attacked by molten Ti, Zr, and Cr. Author

N64-17791* Michigan U., Ann Arbor

LIQUID-VAPOR EQUILIBRIUM IN THE SYSTEM NORMAL HYDROGEN-HELIUM

W. B. Streett (Ph.D. Thesis), R. E. Sonntag, and G. J. Van Wylen Sep. 1963 150 p refs
(NASA Contract NAS8-5256)
(NASA CR-53343; Rept. 05664-1-T) OTS: $11.50 ph, $4.70 mf

Experimental vapor and liquid phase compositions are presented for the binary system normal hydrogen–helium, covering the temperature range 15.50° to 32.50° K and pressures up to 500 psia. The critical curve is located in the temperature range 30.6° to 32.5° K. The behavior of the system, as described by P-x, T-x, and P-T plots, is typical of binary systems in which the critical points are far apart. The experimental equipment consists of a vapor recirculating equilibrium system with a vapor pressure controlled liquid hydrogen bath. A detailed description of the construction and operation of the equipment is included. A comparison of the experimental results with previous work is given, and conflicts in existing data are resolved. The problems of rigorous thermodynamic analysis of the data are briefly discussed. Author

N64-17804 Bureau of Mines, College Park, Md. College Park Metallurgy Research Center
MAGNETIZATION DELAY IN THE SEPARATION OF MINERALS
Foster Fraas 1964 17 p refs
(BM-RI-6411)

The response of minerals in magnetic separators is in accordance with dynamic rather than static magnetic susceptibility values. The dynamic value varies with respect to both passage speed through the separating field and time of exposure in a preliminary treatment field. Author

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-16919 College of Aeronautics, Cranfield (Gt. Brit.)
THE REALIZATION OF FOURTH-ORDER RATIONAL TRANSFER FUNCTIONS WITH ADJUSTABLE COEFFICIENTS
R. J. A. Paul Jun. 1963 27 p refs
(CoA-N-E and C-1)

Design techniques are described for the simulation of third-order and fourth-order rational transfer functions with adjustable coefficients. The realization procedure, which is based on the use of an ideal computing amplifier associated with linear passive RC two-port networks, is an extension of the methods described previously for quadratic functions. Author

N64-16925 European Atomic Energy Community, Brussels (Belgium)
COMPUTER PROGRAM SYSTEM FOR A QUANTITATIVE ANALYSIS BY NEUTRON ACTIVATION AND GAMMA-RAY SPECTROMETRY
A. Borella and G. Guzzi Joint Nuclear Res. Center, Ispra Establishment (Italy), Chemistry Service, Feb. 1964 34 p refs
(EUR 531.e) Available from Belgian American Bank and Trust Co., N.Y., account No. 121.86: 70 Belg. Fr.

A simple and flexible program has been adapted to the needs of the chemical laboratory. This program allows a quantitative analysis of the gamma spectra of the radioactive isotopes used in the laboratory to determine the activity of some samples. The gamma spectra, punched on a high speed tape connected to the gamma spectrometer, are transferred to IBM cards by means of the digital computer IBM 1620. The calculations are then made by an IBM 7090 computer. The program, the write-out of data, and the results are annexed. Author

N64-16943 Queen's U., Kingston (Canada)
THE ZERO-CROSSING PROBLEM
Hans Levenbach Sep. 1963 116 p refs
(Contract DRB/313002/0004/713-22-30-763)
(Res. Rept. 63-4)

An expository survey of the zero-crossing problem is presented. The zero-crossing problem is concerned with the probabilities and probability densities defined by the zero-crossing points of a stationary random process. At present, none of the probabilities or probability densities can be derived explicitly by analytical means. The most basic theoretical results available are derived in order to demonstrate the complexity of the problem. These results are applied to the case of the gaussian processes. Illustrations are provided for comparing the empirical and theoretical results. Finally, a complete list of the mathematical, physical, and engineering references is compiled, including those of closely related topics. Author

N64-16948 Laboratoire de Physique Theorique et des Hautes Energies, France
HARTREE-FOCK METHODS FOR DEGENERATE CASES
Bernard Bremond Feb. 1964 13 p refs

A method giving a fully self-consistent minimization of a Hamiltonian with respect to a sum of two Slater determinants is developed so that it yields a self-consistent diagonalization of Hartree–Fock solutions in degenerate cases. The method is extended to the pairing case. The equations giving eigenvalues of small oscillations around equilibrium are then derived. Author

N64-16951 David Taylor Model Basin, Washington, D.C. Applied Mathematics Lab.
A TRANSISTORIZED EXPANDED TRANSLATOR FOR THE UNIVAC MOD 407 CARD-TO-TAPE CONVERTER
H. Lee Hancock, Jr. Dec. 1963 50 p ref
(Rept. 1768; AD-431559)

This report summarizes the design, development, and construction of a Transistorized Translator to expand the Mod 407 Remington Rand Card-To-Tape Converter (48-character format) to a full 63-character format converter. The logical design, circuit design, and construction, as well as the additional circuitry required for the comparison module, are described and discussed. Author

N64-16967 National Cash Register Co., Dayton, Ohio Military Development and Marketing Dept.
HIGH RESOLUTION RAPIDLY PROGRAMMABLE MASKING FOR FUNCTIONAL ELECTRONIC BLOCKS Interim Engineering Report
Mark Sobottke et al 10 Feb. 1964 38 p
(Contract AF 33(615)-1158)
(NCR-28-11; AD-431292)

The objective of this program is to provide new low-cost programable maskmaking of high resolution. A study and investigation phase, in progress, includes the areas of maskmaking requirements, positioning systems, and optical techniques. Target specifications and a general approach for an engineering model have been defined. Author

N64-16973 RAND Corp., Santa Monica, Calif.
NONLINEAR INTEGRAL EQUATIONS OF RADIATIVE TRANSFER
Thomas W. Mullikin Apr. 1963 51 p refs Presented at an Advanced Seminar on Nonlinear Integral Equations, Math. Res. Center, Wisconsin U., Madison, 22–24 Apr. 1963
(Sponsored by AF; Proj. RAND)
(P-2736; AD-402288)

One of the relatively simple problems in the theory of radiative transfer is discussed. This is the problem of determining quantitatively the intensity of radiation (neglecting polarization and the redistribution of absorbed radiation) in a homogeneous, plane-parallel atmosphere that is of finite thickness and infinite lateral extent, and that is exposed to monochromatic radiation impinging on one side of the atmosphere from a given direction. This problem also describes the transport of monoenergetic neutrons in a subcritical slab reactor. The derivation of some of the nonlinear equations that are involved in the solution of the problem is described. (The nonlinear equations are derived from the transport equation.) It is shown that the same functions can be obtained as solutions to linear singular integral equations. With these linear equations, it is possible to do precise existence and uniqueness studies. For the sake of simplicity, derivations are restricted to the case of isotropic scattering. However, the results obtained can be extended to anisotropic scattering. I.v.L.

N64-16976 Army Missile Test and Evaluation Directorate, White Sands Missile Range, N. Mex. Electro Mechanical Lab. Div.

MATH MODEL OF GRAVITY TORQUES AND INTERNAL TORQUES CAUSED BY GYROS AND INERTIA WHEELS ON AN EARTH-POINTING ORBITING VEHICLE

James S. Pappas Feb. 1964 69 p
(AMTED-TN-52; AD-431242)

This paper derives the math model for simulation purposes of an earth-pointing-orbiting vehicle. The gravity torques on the vehicle are derived as a function of the geometrical mass distribution matrix—that is, the vehicle inertia matrix, and the orientation of body principal axes with respect to local vertical. Torques on the vehicle due to internal rotating devices, such as gyros, flywheels, etc., are also derived. Author

N64-16979 Sylvania Electric Products Inc., Mountain View, Calif. Electronic Defense Labs.

APPROXIMATIONS FOR SOME RADIAL MATHIEU FUNCTIONS

James E. Burke 1 Nov. 1963 16 p refs
(Contract DA-36-039-AMC-00088 (E); Contract DA-36-039-AMC-03404(E))
(EDL-M630; AD-431889)

Approximations are given for radial Mathieu functions of the first kind ($J_{jm}(h,\cosh \mu)$, j = e,o) and second kind ($N_{jm}(h, \cosh \mu)$), and for their derivatives with respect to μ, for m = 0, 1, and ζ. The results are essentially truncated series involving polynomials and the logarithm of $t = (h/\zeta)\cosh \mu$. For a fixed value of t, our expansions are valid for the full range of $\rho = \tanh \mu$, i.e., $0 \leq \rho \leq 1$. Analogous expansions have been obtained by others, but only for the special case $\rho = 0$. Author

N64-17004 Queen's U., Belfast (Northern Ireland)

A DIGITAL COMPUTER METHOD OF LOCATING HIGH ALTITUDE VAPOUR RELEASES

In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 10–12 refs (See N64-17002 09-23)

A method of determining accurately the position of a high-altitude vapor cloud with the help of an electronic digital computer is described. The method depends on data read from simultaneous photographs of the cloud from two or more camera positions. Author

N64-17074 California U., Livermore Lawrence Radiation Lab.

SOPHIST-5, AN IBM 7090/7094 FORTRAN II CODE WHICH CALCULATES MULTIGROUP ENERGY TRANSFER MATRICES FOR ANISOTROPIC ELASTIC SCATTERING OF NEUTRONS

Eugene Canfield 18 Dec. 1963 32 p refs
(Contract W-7405-ENG-48)
(UCRL-7624) OTS: $0.75

SOPHIST-5 (a FORTRAN II code for the IBM 7090/7094) calculates anisotropic-elastic scattering matrices for multigroup neutronic calculations. The output is suitable for diffusion or "transport-corrected" SN codes of 120 groups or less. The input uses cross sections expressed as Legendre expansions (through $\ell = 6$) in terms of laboratory or center-of-mass scattering cosines. Author

N64-17122 Northwestern U., Evanston, Ill. Technological Inst.

A LINEAR PROGRAMMING APPLICATION OF A LEFT INVERSE OF A BASIS MATRIX

A. Charnes and M. Kirby Nov. 1963 21 p refs
(Contract Nonr-1228(10))
(ONR Res. Mem. 91; AD-431538)

The purpose of this paper is to show that linear programing theorems can just as easily be proved by using a left inverse of a basis matrix in place of the ordinary inverse. It is demonstrated that such a left inverse always exists and reduces to the regular inverse in the event that the basis matrix is square. It is also demonstrated that, even though the left inverse is not unique, it can still be used to give a unique expression for any P_j in terms of the basis, where P is an mxn matrix and the columns of P are P_j, j = 1...n. R.T.K.

N64-17151 Goodyear Aerospace Corp., Akron, Ohio

STUDY OF ELASTIC SWITCHING FOR ASSOCIATIVE MEMORY SYSTEMS Final Report

R. T. Hunt, D. L. Snider, J. Suprise, and H. N. Boyd Griffiss AFB, N.Y., Inform. Processing Branch, Feb. 1964 50 p
(Contract AF 30(602)-3103)
(RADC-TDR-63-483; AD-432041)

Various ferrite materials were tested for elastic switching properties that will increase the speed of associative memory systems. The S/N ratios, output voltages, and maximum speed of operation were studied for various temperatures, bias currents, and read-current drive requirements. Several materials had S/N ratios higher than 2 to 1 in operation under nominal conditions. Changes in temperature up to 70° C did not impair the elastic switching properties. Output voltages varied linearly and in proportion to changes in temperature—approximately 20% for most materials for a change from room temperature to 70° C. The S/N ratios were fairly constant to 70° C. The maximum speed of operation was determined as 10×10^6 interrogations per second. The optimum size of an elastic switching memory was also considered. Estimates show that a memory of 1,000 words with lengths up to 100 bits appears feasible for a single set of peripheral circuitry. Author

N64-17164* Michigan U., Ann Arbor

MAXIMUM LIKELIHOOD ESTIMATION IN FINITE STATIONARY ERGODIC MARKOV CHAINS AND A STRONG CONVERSE TO THE CODING THEOREM FOR CONTINUOUS MEMORYLESS CHANNELS

Uppuluri Venkata Ramamohana Rao (Ph.D. Thesis—Indiana U.) 1963 70 p refs
(NASA Grant NsG-2-59)
(NASA CR-53084) OTS: $6.60 ph, $2.30 mf

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Part I: MAXIMUM LIKELIHOOD ESTIMATION IN FINITE STATIONARY ERGODIC MARKOV CHAINS U. V. R. Rao 39 p refs (See N64-17165 09-20)
Part II: A STRONG CONVERSE TO THE CODING THEOREM FOR CONTINUOUS MEMORYLESS CHANNELS U. V. R. Rao 25 p refs (See N64-17166 09-20)

N64-17165 Michigan U., Ann Arbor
MAXIMUM LIKELIHOOD ESTIMATION IN FINITE STATIONARY ERGODIC MARKOV CHAINS
Uppuluri Venkata Ramamohana Rao *In its* Maximum Likelihood Estimation in Finite Stationary Ergodic Markov Chains and a Strong Converse to the Coding Theorem for Continuous Memoryless Channels 1963 39 p refs (See N64-17164 09-20) OTS: $6.60 ph, $2.30 mf

The maximum likelihood equation estimate (MLEE) of a parameter is studied. It is shown that the MLEE of a vector-valued parameter, on which a finite stationary ergodic Markov chain depends, is efficient (in the sense of asymptotic minimum variance) relative to the class of Fisher consistent, differentiable estimates. The properties of the MLEE of a vector parameter on which a finite stationary ergodic Markov chain depends are discussed when there are functional relationships in the parameter space. The ideas of Aitchison and Silvey are used in establishing the existence of a root of the system of likelihood equations. It is shown that this root is unique, consistent, asymptotically normally distributed, continuous, and differentiable. It is still undecided whether this MLEE is efficient relative to the class of Fisher consistent, differentiable estimates.
Author

N64-17166 Michigan U., Ann Arbor
A STRONG CONVERSE TO THE CODING THEOREM FOR CONTINUOUS MEMORYLESS CHANNELS
Uppuluri Venkata Ramamohana Rao *In its* Maximum Likelihood Estimation in Finite Stationary Ergodic Markov Chains and a Strong Converse to the Coding Theorem for Continuous Memoryless Channels 1963 25 p refs (See N64-17164 09-20) OTS: $6.60 ph, $2.30 mf

The last known result on the strong converses for continuous channels is due to Kemperman, who considered a continuous memoryless channel with bounded input and additive gaussian noise. In an abstract, Kemperman announced more general results for continuous channels. The ideas of Kemperman are used to approximate the given continuous channel by a semi-continuous channel and to generalize Kemperman's strong converse for a class of continuous memoryless channels with bounded input.
R.T.K.

N64-17197 Alabama U. Research Inst., Huntsville
PROBLEMS OF WAVE PROPAGATION
F. J. Tischer *In* Md. U. Proc. of the Space Communications Inst., Md. U., College Park, Jun. 23–28, 1963 1963 p 36–50 refs (See N64-17194 09-08) OTS: $9.10 ph, $3.50 mf

Equations are derived for: (1) waves in an infinite, source-free region of a uniform medium (wave equations, wave functions, and magnetic-field intensity); (2) wave functions in rectangular, cylindrical, and spherical coordinate systems for harmonically varying sources; (3) the expression of the relationships between wave functions in different coordinates, using a mathematical approach, by expressing a specific wave function by another one by mathematical manipulation, and using a physics approach wherein spherical waves are expressed by cylindrical wave functions; (4) wave propagation in nonuniform media including the derivation of an equation that permits the representation of the Doppler shift in closed form; and (5) wave propagation in plasma.
I.v.L.

N64-17206* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
TABLE OF PERIOD GENERATORS
L. D. Baumert 1 Nov. 1962 32 p refs
(NASA Contract NAS7-100)
(NASA CR-53207; JPL-TR-32-564) OTS: $3.60 ph, $1.16 mf

A table of logics for digital countdown circuits of periods 4 through 2,047 is given. In addition, a complete exposition of the underlying theoretical results and a brief discussion of applications is presented.
Author

N64-17224* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A GEOMETRICALLY NONLINEAR THEORY OF SHELLS
Bayard Wilson 7 Nov. 1963 58 p refs
(NASA Contract NAS7-100)
(NASA CR-53219; JPL-TR-32-584) OTS: $5.60 ph, $1.94 mf

A general formulation of a geometrically nonlinear theory of shells is developed, utilizing basic concepts from vector and tensor analyses. Large deflections and rotations are considered, consistent with the assumption of linear stress–strain relations. In addition, the fundamental Kirchhoff hypothesis is introduced to reduce the shell problem to one of two dimensions. After the general theory governing the equilibrium configurations of a shell structure is established, the condition of stable or unstable equilibrium is considered.
Author

N64-17240 Los Alamos Scientific Lab., N. Mex.
BODPRO: AN ULTRACENTRIFUGAL BOUNDARY DIAGNOSTIC COMPUTER PROGRAM
P. N. Dean, G. R. Shepherd, and B. J. Noland 12 Feb. 1964 35 p refs
(Contract W-7405-ENG-36)
(LA-3026) OTS: $0.75

A computer program has been designed for the complete analysis of ultracentrifugal ultraviolet sedimentation boundaries. This Boundary Diagnostic Program (BODPRO) is completely general and is applicable to any sedimentable substance that can produce an ultraviolet boundary in the ultracentrifuge.
Author

N64-17246 Joint Publications Research Service, Washington, D.C.
STRONG AND WEAK REDUCIBILITY OF ALGORITHMIC PROBLEMS
A. A. Muchnik 19 Mar. 1964 23 p refs
(JPRS-23760; OTS-64-21836) OTS: $0.75

An M-problem is the problem of constructing an arithmetic function satisfying certain conditions. To each M-problem, there corresponds a certain degree of difficulty (or degree of unsolvability) on which it is possible to define conjunction, disjunction, and other operations of the calculus of prediction. The definition of reducibility (strong or weak) of a family of functions is basic in the calculus of M-problems. Some theorems of the calculus that results from the definition of strong and weak reducibility of algorithmic problems are proven, and an extension of these concepts to the theory of infinite games is included.
E.W.

N64-17264 Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
TURBO—A TWO DIMENSIONAL FEW-GROUP DEPLETION CODE FOR THE IBM-7090
S. M. Hendley and R. A. Mangan Mar. 1964 132 p refs
(Contract AT(30-1)-3017)
(WCAP-6059)

TURBO solves the few group, 2-dimensional (xy geometry) neutron-diffusion equations in combination with a pointwise burnup calculation for the determination of reactivity-lifetime relationships. This version of TURBO for the IBM-7090 is based on the IBM-704 TURBO, that utilizes single line relaxation. TURBO contains a calculation of the effect of power density on resonance capture in uranium 238. The number of lethargy groups is restricted to 2 or 4, and the number of points of solution is limited to 7,500. Author

N64-17313 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
NUMERICAL ANALYSIS OF STIFF EQUATIONS
G. Emanuel 29 Jan. 1964 41 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-380; TDR-269(4230-20)-3; AD-431750)

The interaction between a stiff equation and several common integration procedures is examined. Runge–Kutta is the first procedure considered. A convergence condition is derived that can be used to control the integration step size. Truncation error estimates are also shown to be misleading and of limited usefulness for this procedure. A generalized Adams predictor–corrector procedure is examined in detail with regard to stability. A technique for maximizing the step size is introduced and applied to the generalized Adams procedure. The resulting procedure is appreciably faster than the more conventional one. The analysis also shows that the computation speed of any Adams method decreases as the order of the procedure increases. Author

N64-17336 Radio Corp. of America, Burlington, Mass. Aerospace Systems Div.
TARGETING PROGRAM (TARGP1) USERS MANUAL, VOLUME II Final Report
[1963] 38 p ref
(Contract AF 04(695)-273)
(SSD-TDR-63-402, Vol. 2; AD-432696)

The direct-ascent targeting program (TARGP1) was written to facilitate the choice of the optimum rendezvous trajectory needed by a given vehicle to intercept an orbiting target. The purpose of the program is to generate the set of trajectories that provide the maximum amount of fuel remaining after adaptation. Inputs to the program are the following: (1) target orbital elements, (2) booster and final stage vehicle characteristics, (3) launch site coordinates, (4) range safety restrictions, (5) initial time and final time desired, and (6) control data for aim point selection method. P.V.E.

N64-17349 Joint Publications Research Service, Washington, D.C.
USE OF AUTOMATIC DEVICES IN CONTROL UNITS OF DIGITAL COMPUTERS
V. I. Kartashov 23 Mar. 1964 10 p refs Transl. into ENGLISH from Avtomatyka (Kiev), v. 8, no. 6, 1963 p 11–16
(JPRS-23816; OTS-64-21867) OTS: $0.50

A method is discussed for combining the desired microprograms of operations, which have identical sequences of microoperations in any parts of the microprograms, for the purpose of finding a single automatic device for carrying out all microoperations. This method deals with the building of a cycle-formation automatic device. I.v.L.

N64-17366 Aeronautical Systems Div., Wright-Patterson AFB, Ohio Flight Dynamics Lab.
DIGITAL COMPUTER PROGRAM FOR THERMO-ELASTIC SOLUTION OF STATICALLY DETERMINATE (UNRESTRAINED) BEAMS BY FINITE SUM
James R. Johnson Jun. 1962 25 p ref
(ASRMDS-TM-62-35; AD-432453) OTS: $2.60

This report describes an available IBM 7090 Computer Program that will calculate the stresses and deformations of cross sections of statically determinate beams due to mechanical or thermal loading and combined mechanical and thermal loading. The formulation of this analysis within the limitations of linear elastic theory and solution by the finite sum technique provides rapid answers to practical problems. Author

N64-17512 Brown Engineering Co., Inc., Huntsville, Ala.
A FORTRAN SUBROUTINE FOR CALCULATING THE THERMODYNAMIC PROPERTIES OF EQUILIBRIUM AIR
G. R. Guinn and J. G. Floyd Nov. 1963 62 p refs
(Tech. Note R-79; AD-432286)

This report describes an IBM 7040 FORTRAN computer subroutine for calculating the approximate thermodynamic properties of equilibrium air. Electron concentrations at the high- and intermediate-density ranges are obtained from curve fits of more precise calculations. Author

N64-17517* Wisconsin U., Madison Theoretical Chemistry Inst.
ANALOGIES BETWEEN HIGHER-ORDER ANALYTICAL AND NUMERICAL PERTURBATION-ITERATION METHODS
R. A. Sack Repr. from J. Chem. Phys., v. 39, no. 12, 15 Dec. 1963 p 3275–3276 refs
(NASA Grant NsG-275-62(4180))

An analogy is pointed out between Hirschfelder's perturbation–iteration method for the determination of eigenvalues and eigenfunctions of linear differential operators and Roothaan's numerical procedure applicable to finite matrices. An analytical procedure analogous to Ostrowski's third-order matrix method is shown to lead to unmanageable differential equations. Author

N64-17560* New York U., N.Y.
A NEW ALGORITHM FOR DIAGONALIZING A REAL SYMMETRIC MATRIX
C. Donald La Budde Repr. from Math. Computations, v. 18, no. 85, Jan. 1964 p 118–123 refs
(NASA Grant NsG-76-60)

The algorithm described in this paper is essentially a Jacobi-like procedure employing Householder and Jacobi orthogonal similarity transformations successively on a real symmetric matrix to obtain, in the limit, a diagonal matrix of eigenvalues. The columns of the product matrix of all the orthogonal transformations, taken in the proper order, form a complete orthonormal set of eigenvectors. Author

N64-17568* Martin Co., Baltimore, Md. RIAS Div.
OPTIMAL BANG-BANG CONTROL WITH QUADRATIC PERFORMANCE INDEX
W. M. Wonham and C. D. Johnson (Purdue U.) Repr. from Joint Autom. Control Conf., 4th, 1963 p 101–112 refs
(NASA Contract NASr-103; NSF Grant 16460; Contract AF 49(638)-1206)

Consider the control system defined by $\dot{x} = Ax + u(t)f$ ($\cdot = d/dt$) (1) where $x = (x_1, \ldots, x_n)$ is the state vector of the plant, A is an (n x n) constant matrix, $f = (f_1, \ldots, f_n)$ is a constant n-vector, and u(t) is the scalar control function. In this paper, eq. (1) is considered with performance index $1/2 \int_0^T (x, Qx)dt$ and constraint $|u| \leq 1$. An unusual feature of the solution is that, in general, the control is "singular" but of form $u^* = (\gamma, x)$, for states x in a set R containing the origin, and is bang-bang otherwise. The model is applicable in situations where control cost as measured by $\int u^2 dt$ is unimportant, but where it is desirable to retain the practical advantages of dual-mode control. Author

N64-17569 New York U., N.Y. AEC Computing and Applied Mathematics Center
CONVERGENCE OF THE QR ALGORITHM
Beresford Parlett 18 Feb. 1964 19 p refs
(Contract AT(30-1)-1480)
(NYO-10432)

The QR algorithm of J. G. F. Francis is used in computing matrix eigenvalues. The convergence proof given is an analog of Rutishauser's proof of the convergence of the LR algorithm. Author

N64-17578* Illinois U., Urbana Electrical Engineering Research Lab.
A FORTRAN COMPUTER PROGRAM FOR DETERMINING THE EARTH'S MAGNETIC FIELD
Richard H. Eckhouse, Jr. 1 Feb. 1964 21 p refs
(NASA Grant NsG-24-59)
(NASA CR-53176) OTS: $2.60 ph, $0.83 mf

The program, written in FORTRAN IV, was specifically designed for Faraday rotation studies, but because of its generality, it is applicable to almost any type of experimental study where a spherical harmonic expansion of the geomagnetic field is desired. The spherical harmonic expansion uses the 48 coefficients of Jensen and Cain, which result in terms of sixth order and sixth degree. The equations require little computer time for solution, and the program itself was designed as a subroutine for the IBM 7094. E.W.

N64-17594* Michigan U., Ann Arbor Radiation Lab.
APPLICATION OF CONFORMAL MAPPING TO RADIATION AND DIFFRACTION OF ELECTROMAGNETIC WAVES
Soonsung Hong 25 Feb. 1964 3 p Submitted for publication
(NASA Grant NsG-444)
(NASA CR-53288) OTS: $1.10 ph, $0.80 mf

A method of mapping the radiation or diffraction of electromagnetic waves from an infinite cylinder of arbitrary cross section in a homogeneous isotropic medium is presented. The method is an extension of the techniques of Keller and Fock and can be applied to boundaries that have a discontinuity in curvature. The method makes use of the fact that a closed convex cylinder with or without discontinuity of curvature can be conformally mapped into a circular or a smooth curve, where there is no discontinuity of curvature and the Green's function is known. P.V.E.

N64-17619 Uppsala U. (Sweden) Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory
ANALYTIC PROPERTIES OF ONE-DIMENSIONAL BLOCH FUNCTIONS
Gert Eilenberger 15 Aug. 1963 32 p refs
(TN-105; ARL-64-38; AD-432039)

The analytic properties as functions of wave number k of the solutions of a single-electron Schrödinger equation for one-dimensional periodic potentials with inversion symmetry have been treated by Kohn for nonconnected energy bands. In this paper, Kohns results are generalized in order to include the case of missing inversion symmetry and connected bands; already known results are reviewed to a certain extent in order to treat the generalizations in a closed frame. Author

N64-17623 Wisconsin U., Madison
A VALUE-REGION PROBLEM OCCURRING IN THE THEORY OF CONTINUED FRACTIONS Technical Summary Report
F. V. Atkinson Dec. 1963 29 p refs
(Contract DA-11-022-ORD-2059)
(MRC-419; AD-433474) OTS: $2.60

This paper deals with an extremal problem for the function $F(z_1, z_2, \cdots) = 1 + z_1 + z_1z_2 + z_1z_2z_3 + \cdots$, (1) where $z_1, z_2, z_3, \cdots$ are taken arbitrarily from a closed disk C in the complex plane; C is taken to be specified by $|z - \alpha| \leq \beta$ and α, β are real and subject to $0 < \alpha < \beta < 1 - \alpha$. These conditions imply that the z_r satisfy $|z_r| \leq \alpha + \beta < 1$, so that the series (1) converges absolutely; furthermore, $z_r = 0$ is permitted, so that terminating series of the form (1) are included. R.T.K.

N64-17624 Wisconsin U., Madison
THE ASYMPTOTIC EXPANSION OF THE OUTGOING SOLUTION OF $\Delta u + k^2n^2(x)u = \delta(x)$ NEAR x = 0 Technical Summary Report
G. S. S. Avila Nov. 1963 15 p refs
(Contract DA-11-022-ORD-2059)
(MRC-442; AD-433475) OTS: $1.60

The outgoing solution of the equation $\Delta u + k^2n^2(x)u = \delta(x)$ in three-dimensional space is considered, and its asymptotic expansion

$$u \sim e^{ikS(x)} \sum_{q=0}^{\infty} \frac{v_q(x)}{(ik)^q} \quad \text{for } k \to \infty$$

is investigated in the neighborhood of the origin. Under the assumption that n(x) is an analytic function of x, it is shown that the quantities $v_0 + 1/4\pi|x|$ and $v_q, q > 0$, vanish at x = 0. Author

N64-17625 Wisconsin U., Madison
WEAK CONVERGENCE IN CERTAIN SPECIAL BANACH SPACES Technical Summary Report
S. D. Chatterji Dec. 1963 19 p refs
(Contract DA-11-022-ORD-2059)
(MRC-443; AD-433476) OTS: $1.60

The main result of this report is a theorem that gives a set of necessary and sufficient conditions that ensure the weak compactness of a set in the space of Bochner–integrable functions on a finite measure space taking values in a reflexive Banach space. The conditions and the proof are analogous to those in the scalar-valued case. The three other theorems in the report and their proofs give preparatory material, including a description of linear functionals on the space mentioned above and its weak completeness. Author

N64-17635 Wisconsin U., Madison
A SOLUTION OF EINSTEIN'S FIELD EQUATIONS FOR A ROTATING, STATIONARY, AND DUST-FILLED UNIVERSE Technical Summary Report
James P. Wright Dec. 1963 12 p refs
(Contract DA-11-022-ORD-2059)
(MRC-448; AD-433478) OTS: $1.60

The solution of Einstein's field equations,

$$R_{ij} - \frac{1}{2} g_{ij}R = 8\pi\kappa\rho u_i u_j + \lambda g_{ij},$$

for a line element of the form $ds^2 = (dx^0)^2 - \delta^2(x^1)(dx^1)^2 + 2\beta(x^1)dx^0dx^2 - \gamma^2(x^1)(dx^2)^2 - \alpha^2(x^1)(dx^3)^2$ is found. The density, ρ, may be a function of position, and the cosmological constant λ is not necessary in order to have a finite density. The solution reduces to that of Godel if the variable α is constant. If the requirement for an empty universe is made ($R_{ij} = 0$), the solution is conformally flat. The characteristics of the conformal curvature tensor are also obtained. Author

N64-17636 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

DETERMINATION OF SOME PROCEDURES WITH A HIGH ORDER OF EXACTNESS FOR THE NUMERICAL INTEGRATION OF DIFFERENTIAL EQUATIONS

A. Cotiu 4 Dec. 1963 23 p refs Transl. into ENGLISH by JPRS from Analele Stiint. Univ., "Al. I. Cuza" Iasi, Sect. I, v. 6, 1960 p 585–598
(RSIC-104; AD-432547)

Procedures of a high order of exactness are established for the numerical integration of first-order differential equations that require a very small number of substitutions. A procedure is established of seventh-order exactness requiring only two substitutions in the differential equation, along with a procedure of seventh-order exactness requiring only three substitutions. A procedure is also established for the eighth order of exactness requiring three substitutions. C.L.W.

N64-17639 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

COORDINATE SPACES AND INFINITE SYSTEMS OF LINEAR EQUATIONS. II

Y. I. Gribanov 25 Feb. 1964 16 p refs Transl. into ENGLISH by JPRS from Izv. Vysshikh Uchebn. Zavedenii, Mat. (Moscow), v. 23, no. 1 1963 p 66–74
(RSIC-140; AD-432804)

This report deals with the following areas: (1) the general form of linear operators in coordinate spaces; (2) the general properties of matrix operators in coordinate spaces; and (3) tests for the continuity of matrix operators in coordinate spaces. I.v.L.

N64-17641 RAND Corp., Santa Monica, Calif.

EXISTENCE, CHARACTERIZATION, AND CONVERGENCE OF BEST RATIONAL TCHEBYCHEFF APPROXIMATIONS

Barry W. Boehm Mar. 1964 99 p refs
(Contract AF 49(638)-700)
(R-427-PR; AD-432186)

The existence, characterization, and convergence of best rational Tchebycheff approximations are reviewed. A theorem is proved that states that a best rational approximation,

$$r^* = \frac{a_1^* g_1 + \ldots + a_n^* g_n}{b_1^* h_1 \qquad\qquad b_m^* h_m}$$

to a continuous, bounded function f, defined on an arbitrary topological space X, exists whenever the numerator and denominator functions g_i and h_j are continuous, bounded functions for which the corresponding generalized rational functions are always defined on X. Several variations of this basic existence theorem are treated, including some theorems for weighted rational approximation, constrained rational approximation, and approximation by nonlinear families similar in nature to rational functions. Theorems are presented that characterize functions whose best Tchebycheff approximations on an interval [a, b] of the real line by rational functions are always polynomials. Also, theorems are presented that concern the convergence of best rational Tchebycheff approximations to continuous functions on an interval [a, b]. I.v.L.

N64-17664 Lincoln Lab., Mass. Inst. of Tech., Lexington

A MULTI-CAVITY KLYSTRON COMPUTER PROGRAM INCLUDING POTENTIAL DEPRESSION CORRECTION

S. F. Catalano, C. Guay, G. L. Guernsey, R. L. Pease, and M. E. Schwarz, Jr. 29 Aug. 1963 35 p refs
(Contract AF 19(628)-500; ARPA Order 85)
(Rept. 43G-1; AD-420687)

This report describes a computer program that may be used to investigate the characteristics of a multicavity klystron. It is written for the IBM 7090 in FORTRAN. It is written for solid or hollow beam klystrons. For maximum flexibility it is in the form of several subroutines connected by a master control program. It is complete in the sense that it leaves nothing for the user to compute manually. Author

N64-17712 Joint Publications Research Service, Washington, D.C.

INVESTIGATION ON AN ELECTRONIC COMPUTER OF CONTINUOUS MODELS OF CONTROL SYSTEMS

I. P. Lukashevich 25 Mar. 1964 12 p refs Transl. into ENGLISH from Biofizika (Moscow), v. 8, no. 6, 1963 p 715–721
(JPRS-23864; OTS-64-21892) OTS: $0.50

A description is given of a mathematical model that is a discrete analog of a continuous control system. The model is a medium in which every point is capable of excitation, which is instantaneous. Excitation may be spread in the medium, and each point has spontaneous activity. The medium consists of identical elements, identically united among themselves. The distinguishing characteristics of this model lay in the determination of the phase of a point, the character of the excitation, and the method of its transmission. C.L.W.

N64-17714 Joint Publications Research Service, Washington, D.C.

AN ALGOL-60 CONVERTER

M. R. Shura-Bura and E. Z. Lyubimskiy 31 Mar. 1964 22 p Transl. into ENGLISH from Zh. Vychishitel'noi Mat. i Mat. Fiz. (Moscow), v. 4, no. 1, Jan.–Feb. 1964 p 96–112
(JPRS-23955; OTS-64-21949) OTS: $0.75

The main features and input language of the TA-2 converter are described. The TA-2 translator is designed for converting ALGOL-60 programs into machine language. The translator is organized on a block principle. All information that is processed and created is stored on magnetic drums. Included in the internal language of the translator is a single system of tables and references providing quick and convenient searching of the necessary block of information, and also the connection of information already on hand to new information without reallocation and transcribing. Each of the blocks can be replaced without interfering with other blocks. R.T.K.

N64-17717 Oak Ridge National Lab., Tenn. Neutron Physics Div.

INTRIGUE, AN IBM-7090 SUBROUTINE PACKAGE FOR MAKING LINEAR, LOGARITHMIC AND SEMILOGARITHMIC GRAPHS USING THE CALCOMP PLOTTER

M. B. Emmett Mar. 1964 16 p refs
(Contract W-7405-ENG-26)
(ORNL-3581) OTS: $0.50

An IBM-7090 subroutine package has been written to facilitate the plotting of curves and points on linear, logarithmic, and semilogarithmic graphs using the CALCOMP plotter. The subroutines accomplish the necessary computations and prepare a magnetic tape for use by the plotter. Author

N64-17722* National Aeronautics and Space Administration, Washington, D.C.
ON B. G. GALERKIN'S METHOD FOR THE SOLUTION OF BOUNDARY VALUE PROBLEMS [O METODE B. G. GALERKINA DLYA RESHENIYA KRAYEVYKH ZADACH]
M. V. Keldysh Mar. 1964 58 p Transl. into ENGLISH by Faraday Translations from Izv. Akad. Nauk SSSR, Ser. Mat. (Moscow), v. 6, no. 4, 1942 p 309–330
(NASA TT F-195) OTS: $1.50

Galerkin proposed a method for the solution of boundary-value problems of ordinary differential equations. This method does not depend on the variational nature of problems and may therefore be applied to non-self-adjoint equations. In this paper the applicability of the method to some classes of differential equations is proven. The general ordinary differential equation of order 2n are considered. A detailed investigation is presented of all boundary conditions of the second-order equation, which relate to the values of the functions, and of the derivative at each endpoint of the interval. The Dirichlet problem for partial differential equations is considered. The convergence (in the mean) of the solutions and the convergence of the eigenvalues are established in the general case. Author

N64-17724* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
THE BACKWARD RECURRENCE METHOD FOR COMPUTING THE REGULAR BESSEL FUNCTION
Thomas E. Michels Washington, NASA, Mar. 1964 28 p refs
(NASA TN D-2141) OTS: $0.75

The backward recurrence method for computing the regular Bessel function is investigated for real, imaginary, and complex arguments. From this, the function $J_n(z)$, $I_n(z)$, $ber_n(z)$, and $bei_n(z)$ can be obtained. A section has also been devoted to show the behavior of the functions for all arguments, and graphs are presented that show the magnitudes of the functions for all orders and real arguments between 0 and 6000. Author

N64-17727* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CODING AN ANALOG VARIABLE FOR CONSTANT PERCENTAGE ERROR
Rodger A. Cliff Washington, NASA, Mar. 1964 20 p ref
(NASA TN D-2257) OTS: $0.75

Systems are treated that code an analog variable as a sequence of discrete values. Given one of these discrete values, there is necessarily some uncertainty about what value of the analog input variable produced the discrete output, since there are only a finite number of distinct outputs. This paper investigates the nature of this uncertainty or possible error. It is shown that a logarithmic quantization scheme produces an uncertainty in the output that is constant over the input range that the system is designed to cover. Relationships are derived between the uncertainty that must be tolerated, the width of the input range to be covered, and the number of discrete ouputs required. These relationships are presented both analytically and graphically. Author

N64-17761 Sandia Corp., Albuquerque, N. Mex. Livermore Lab.
RANDOM VIBRATION TERMINOLOGY AND ANALYSIS EQUIPMENT
D. F. Hillyer, Jr. Feb. 1964 62 p refs
(SCL-R-64-40) OTS: $1.75

This paper describes: (1) the common terms occurring in random waveform analysis and the relationships between them; (2) the equipment used to collect and measure laboratory and field data; and (3) the limitations and inaccuracies of equipment as they apply to the statistical quality of the measurements. Included are discussions of broadband and narrowband random noise; stationarity and ergodicity; power spectral density; the accuracy of the mean-square measurement technique; and the swept-filter, real-time, and amplitude probability density analyzers. Author

N64-17812 European Atomic Energy Community, Brussels (Belgium)
A MULTI-DIMENSIONAL, MULTIGROUP, MULTIREGION, NEUTRON DIFFUSION CODE (ITERATIVE-VARIATIONAL APPROACH)
M. Lunelli and G. Maggioni (Milan U.) [Feb.] 1964 165 p refs
(Contract EURATOM 006-60-7-CETI)
(EUR-532.e) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 210 Belg. Fr.

This program, LOUISE III, has been written in FORTRAN for IBM 7090 with the aim of calculating, in the multigroup (up to 10) approximation, the criticality constant and critical fluxes of a multiregion (up to 25) reactor. This code can perform calculations in one, two, three, and more dimensions (up to 7). The problem has been solved by an iterative-variational technique. This method requires suitable stationary conditions on convenient functionals, and the reduction of these stationary conditions to algebraic equations through the choice of a convenient system of basic functions (in this case trigonometric functions). This code has been tested by comparison with results from the WHIRLAWAY code. These results agree very well, especially in the case of the eigenvalue. LOUISE III requires a far smaller execution time. Author

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-16894 National Severe Storms Project, Kansas City, Mo.
SEVERE STORM DETECTION AND CIRCUMNAVIGATION Final Report
Nov. 1963 471 p refs
(Contract FAA-ARDS-A-176)

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3. 500-KC./SEC. SFERICS STUDIES IN SEVERE STORMS D. A. Kohl, J. E. Miller (Gen. Mills), and J. T. Lee 40 p refs (See N63-17912 16-21)

4. MOVEMENTS AND PATTERNS OF DEVELOPMENT OF THUNDERSTORMS C. W. Newton and J. Fankhauser 185 p refs (See N64-16898 09-21)

5. SOME RELATIONS BETWEEN THUNDERSTORM RADAR ECHOES AND SURFACE WIND FIELDS A. B. Arnett 34 p ref (See N64-16899 09-21)

6. ON VECTORING AIRCRAFT THROUGH THUNDERSTORMS C. F. Van Thullenar 13 p (See N64-16900 09-21)

7. ANALYSIS OF THE SEVERE WEATHER FACTOR IN AUTOMATIC CONTROL OF AIR ROUTE TRAFFIC W. B. Beckwith (United Air Lines) 70 p refs (See N64-16901 09-21)

N64-16895 National Severe Storms Project, Kansas City, Mo.

THUNDERSTORM TURBULENCE MEASUREMENTS BY AIRCRAFT AND CONCURRENT RADAR ECHO EVALUATIONS

In its Severe Storm Detection and Circumnavigation Nov. 1963 56 p (See N64-16894 09-21)

Data collected by a T-33 aircraft, flying at an average true airspeed of 360 knots or 608 ft/sec^{-1}, indicated that: (1) Thunderstorm turbulence compared to radar echo intensity does not bear a direct correlation. There appears to be a critical radar reflectivity value of 10^3 mm^6/m^3 at which derived gust velocities can exceed 20 ft/sec^{-1}. (2) There does not appear to be a direct correlation between the gradients of successive radar reflectivity values per se and turbulence. (3) The center and western portions of thunderstorm complexes, as seen at a zero attenuation level, contain the most severe turbulence. (4) Vertical accelerations tend to be biased toward negative values. (5) Rapid changes in vertical accelerations from U_{de} (derived gust velocity) values of -11.8 ft/sec^{-1} to $+$ 17.8 ft/sec^{-1} in 0.2 sec of T-33 flight time have been experienced. (6) Altitude variations of as much as 5,000 ft can occur even with the nose of the aircraft pitched down during a transverse of a thunderstorm cell. Also, the roll and pitch rates may be sufficient for a pilot to lose control of the aircraft if he is not prepared for the turbulence. This was experienced with an F-102 flying at 35,000 ft. I.v.L.

N64-16896 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

INVESTIGATION OF SEVERE STORMS WITH PULSE DOPPLER RADAR

A. J. Chimera and R. L. Peace Oct. 1962 In Natl. Severe Storms Proj. Severe Storm Detection and Circumnavigation Nov 1963 56 p refs (See N64-16894 09-21)

(Contract Cwb-10354)

(CAL-VC-1663-E-1)

During May and June of 1962, a pulse Doppler radar was located at Chickasha, Oklahoma, for the primary purpose of demonstrating the feasibility of detecting and identifying tornadoes on the basis of velocity information determined by pulse Doppler techniques. The addition of USWB support allowed an extended field program to be conducted, and the CAL program was closely coordinated with USWB–NSSP activity. This joint program provided a trial of the experimental radar system under realistic conditions in the field. Although equipment dificulties seriously limited significant results, the experience gained from the program has indicated essential improvements of both the radar system and the operating techniques for future field programs. Author

N64-16898 National Severe Storms Projects, Kansas City, Mo.

MOVEMENTS AND PATTERNS OF DEVELOPMENT OF THUNDERSTORMS

Chester W. Newton and James Fankhauser Jun. 1963 *In its* Severe Storm Detection and Circumnavigation Nov. 1963 185 p refs (See N64-16894 09-21)

The problems of the analysis and short-period forecasting, in the time scale up to two or three hours, of the likelihood of thunderstorm occurrence at a specific point are reviewed. The analysis and forecasting are based on: (1) the determination of the degree of persistence in large convective storms; (2) a study of the characteristic features of the movements of these storms; (3) a description of the characteristic patterns of the development of new storms and the dissipation of old storms; and (4) the determination of parameters that may be useful for short-term extrapolation. I.v.L.

N64-16899 National Severe Storms Project, Kansas City, Mo.

SOME RELATIONS BETWEEN THUNDERSTORM RADAR ECHOES AND SURFACE WIND FIELDS

A. B. Arnett Jun. 1963 *In its* Severe Storm Detection and Circumnavigation Nov. 1963 34 p ref (See N64-16894 09-21)

This study was made utilizing surface observations from stations located within the National Severe Storms Project (NSSP) "Beta" network. The results of this study should be considered in terms of providing some qualitative insight into the expected or probable surface weather conditions accompanying the passage of a thunderstorm, as may be interpreted from an appropriate radarscope presentation of thunderstorm echoes. A program of radar surveillance was carried out that included scope photography of the Weather Bureau's WSR-57 radar located at Oklahoma City. Contours of radar echo intensity were displayed by automatic step-gain reduction. By scaling these contour outlines to a surface map of synoptic wind observations, it is possible to relate surface wind patterns to the various characteristics of the outlines and to the movement of radar echoes. Author

N64-16900 National Severe Storms Project, Kansas City, Mo.

ON VECTORING AIRCRAFT THROUGH THUNDERSTORMS

Clayton F. Van Thullenar Jun. 1963 *In its* Severe Storm Detection and Circumnavigation Nov. 1963 13 p (See N64-16894 09-21)

Severe turbulence (U_{de} = 35 to 50 fps) can be encountered at some point in any storm. In a growing thunderstorm or a large thunderstorm at the mature stage, extreme turbulence (U_{de}> 50 fps) may be present in some part of the storm. It is not uncommon to encounter turbulence in the clear air near a thunderstorm or a line squall. Both positive and negative accelerations have been encountered. Turbulence has been found to increase with altitude up to at least 5,000 ft below the top of the visible cloud, and some records show dangerous turbulence may be encountered immediately above the storm cloud. Hail of some size is present in practically all thunderstorms, and often reaches to within a few thousand feet of the top of the cloud. There is a danger in overflying growing thunderstorms. The rate of vertical growth has been observed to exceed 5,000 ft a minute. Author

N64-16901 United Air Lines, Inc., Chicago, Ill.

ANALYSIS OF THE SEVERE WEATHER FACTOR IN AUTOMATIC CONTROL OF AIR ROUTE TRAFFIC

W. Boynton Beckwith Dec. 1962 *In* Natl. Severe Storms Proj. Severe Storm Detection and Circumnavigation Nov. 1963 70 p refs

(Contract Cwb-10110)

(NSSP-12)

Two severe squall line cases have been studied, using radar, aircraft, upper air, and surface data collected by the National Severe Storms Project. The weather effects of these two

cases on the control of air traffic have been analyzed by using logs of taped conversations received in two Air Route Traffic Control Centers. Confirmation of the thunderstorm echo features from a WSR-57 radar are good when checked against photographs and flight logs of research aircraft flying various patterns around the storms. One flight involves a supersonic penetration of a strong buildup. Verification of related forecasts are made from scope data. Most of the important developments fell within the forecasted areas, but the areas designated are too large to be of operational use except for preliminary planning. The short-range forecast required in the traffic control computer now envisioned can best be satisfied by sequenced radar echo data measured with a variable-gain control. Author

N64-16977 Aracon Geophysics Co., Concord, Mass.
WEATHER RADAR RESEARCH AND STORM DYNAMICS Final Report
Raymond Wexler 31 Dec. 1963 44 p refs
(Contract AF 19(628)-292)
(AFCRL-64-202; ARA-F-9186-3; AD-430520)

The motion of small radar echoes in Hurricane Esther 1961 followed essentially circular trajectories. During the 18-hr period of radar observations maximum speeds decreased with time from near 80 kn to about 40 kn. Many of the band-shaped echoes in Hurricane Esther consisted of a blend of several adjacent bands. Single bands that could be followed moved radially outward at about 8 kn. The upwind end of a band remained in the same quadrant by the continued development of new cells. As the cells moved downwind, they merged, the precipitation became stratiform in character, and the maximum rain intensity was attained about 100 miles downwind. Echo tops were sometimes uniform over the entire band, but at other times showed a maximum either above the region of maximum rain intensity or near the upwind end. Author

N64-17112 Argonne National Lab., Ill.
A NOTE ON ELLIPSOIDAL WIND DISTRIBUTIONS
Harold L. Crutcher (Weather Bur.) and Harry Moses *In its* Radiological Phys. Div. Summary Rept., Jul. 1962–Jun. 1963 Dec. 1963 p 181–196 refs (See N64-17107 09-23) OTS: $3.00

The present paper extends the concept of wind distributions from two to three dimensions. Homogeneous random wind observations may be described by the trivariate normal distribution. A multivariate normal distribution is distributed as chi square with degrees of freedom equal to the number of variates. The probability density function of the trivariate normal distribution can be written as $f(x_1, x_2, x) = C \exp -(1/2) x \sigma^{ij} x'$, where σ^{ij} is the inverse of the positive definite covariance matrix, σ_{ij}, x' is the transpose of the x matrix, and $C = |\sigma ij|^{1/2} (2\pi)^{-3/2}$. In the isotropic case, the distribution will be spherical. In all other cases, except the limiting straight-line form, the distribution will be ellipsoidal with magnitude and direction of the semiaxes determined, respectively, from the eigenvalues and eigenvectors of the covariance matrix. Tests for sphericity or isotropy are shown and application to diffusion problems indicated. Author

N64-17113 Argonne National Lab., Ill.
AN EVALUATION OF WIND PROFILE LAWS BY LEAST SQUARES TECHNIQUES
J. Robert Stinson, Harry Moses, and John E. Pearson *In its* Radiological Phys. Div. Summary Rept., Jul. 1962–Jun. 1963 Dec. 1963 p 197–219 refs (See N64-17107 09-23) OTS: $3.00

An evaluation of wind profile laws by least squares techniques is reviewed. The log plus regression equation gave the best general fit of the three types of regression equations used to study the data. The power law and the logarithmic law proved reasonably accurate, with the power law giving better fit at night and the logarithmic law giving better fit during the day. Deacon's law, when applied by computing a Deacon parameter from the profile data instead of the solution of a regression equation, did not compare favorably with the other three laws. Each of the three profile laws (power law, logarithmic law, and log plus linear law) studied by the use of a regression equation gave good correspondence between observed and computed values. Also, the six anemometers used together and the anemometers used in combinations of top four, middle four, and bottom four showed the profile parameters to be reasonably consistent with height except during periods of very weak winds and strong stability. These results may have useful consequences for routine industrial applications. I.v.L.

N64-17114 Argonne National Lab., Ill.
MAN-MADE IONIZED COLUMNS IN THE ATMOSPHERE – A NEW TOOL FOR METEOROLOGICAL RESEARCH
Harry Moses, Ronald L. Martin, Jacob Kastner, and A. J. Ulrich *In its* Radiological Phys. Div. Summary Rept., Jul. 1962–Jun. 1963 Dec. 1963 p 220–229 refs (See N64-17107 09-23) OTS: $3.00

The use of a high-energy proton or electron beam, directed vertically to act as a probe for the study of atmospheric processes is proposed. An outstanding feature of such an atmospheric probe is its capability to ionize a column of air repeatedly in a few microseconds and in approximately the same place. Characteristics of a vertical proton beam that may be generated by the Zero Gradient Synchrotron are discussed, and calculations are presented to provide an estimate of the ion concentration as a function of height in the atmosphere. The potential uses of an atomospheric ionized column for meteorological research are discussed. Such investigations include the artificial initiation of lightning, the production of atmospheric ozone resulting from lightning, and the line spectra associated with the lightning channel. Author

N64-17284 Aracon Geophysics Co., Concord, Mass.
SYNOPTIC ANALYSIS OF TIROS III RADIATION MEASUREMENTS Final Report
Raymond Wexler and Paul Sherr 31 Jan. 1964 40 p refs
(Contract AF 19(628)-429)
(AFCRL-64-53; AD-431181)

TIROS III radiation measurements during July 1961 are analyzed with respect to radiometer deterioration, limb darkening, cloud-cover determination, and comparisons with surface and 500 mb synoptic analyses. The patterns of Channel 2 (8μ to 13μ) equivalent temperature (T_E) show excellent agreement with TIROS photographs and nephanalyses. They show better agreement with 500 mb than with surface analyses. Lowest T_E values are generally downwind from a major 500-mb trough position. The short wave troughs are depicted by a characteristic crescent shaped T_E pattern. Although the pattern generally shows little relation to summer fronts, there is occasionally an excellent fit with open waves. The T_E patterns are particularly well suited to tropical analysis and show day-to-day continuity in tracing the motion and changes in intensity of disturbed areas. Author

N64-17320 Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
AIR FORCE INTERIM SUPPLEMENTAL ATMOSPHERES TO 90 KILOMETERS
Allen E. Cole and Arthur J. Kantor Dec. 1963 43 p refs
(AF Surveys in Geophys. 153; AFCRL-63-936; AD-432073)

A mean annual Tropical (15° N) Atmosphere and January and July Subtropical (30° N), Midlatitude (45° N), Subarctic (60° N), and Arctic (75° N) Atmospheres have been prepared as supplements to the 1962 U.S. Standard Atmosphere; they provide information on latitudinal and seasonal changes in atmospheric structure up to 90 km. In addition to mean January and July atmospheres, cold and warm atmospheres, reflecting the two winter thermal regimes that have been observed in the arctic and subarctic stratosphere, are presented. Vertical temperature gradients for various altitude segments of each atmosphere are linear with geopotential height. Humidity is incorporated into the pressure and density computations for the lowermost 10 km of each atmosphere. Figures and tables depict temperature, relative humidity, pressure, and density. Author

N64-17339 Joint Publications Research Service, Washington, D.C.
STUDIES IN CLOUD PRECIPITATION AND CONTRAILS
26 Feb. 1964 62 p refs Transl. into ENGLISH of 2 articles from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 47, 1963 p 63–84 and 101–105
(JPRS-23407; OTS-64-21659) OTS: $1.75

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1. RADAR METHOD OF DETERMINING THE PHASE STATE OF CLOUDS AND PRECIPITATIONS V. Ye. Minervin and A. B. Shupyatskiy p 1–49 refs (See N64-17340 09-21)
2. SOME DATA ON THE OCCURRENCE OF CONTRAILS BEHIND AIRPLANES A. F. Nepovitova p 50–59 ref (See N64-17341 09-21)

N64-17340 Joint Publications Research Service, Washington, D.C.
RADAR METHOD OF DETERMINING THE PHASE STATE OF CLOUDS AND PRECIPITATIONS
V. Ye. Minervin and A. B. Shupyatskiy *In its* Studies in Cloud Precipitation and Contrails 26 Feb. 1964 p 1–49 refs (See N64-17339 09-21)

A method is described for determining the phase state of clouds and precipitations based on the use of the dependence of polarizing properties of scattering particles on their forms. The method of observation, its processing, and the method's shortcomings are discussed. A number of examples of the observations of the phase state distribution of cloud particles and precipitations with time and space are presented. Experimental results are compared with airplane and radio sounding data. Some conclusions are made on the possibilities and prospects of the method. Author

N64-17341 Joint Publications Research Service, Washington, D.C.
SOME DATA ON THE OCCURRENCE OF CONTRAILS BEHIND AIRPLANES
A. F. Nepovitova *In its* Studies in Cloud Precipitation and Contrails 26 Feb. 1964 p 50–59 ref (See N64-17339 09-21)

Cases of the appearance of condensation trails behind airplanes in the regions of Aktyubinsk, Alma Ata, and Sverdlovsk, are considered. The author calculates the occurrence of trails by depending on altitude, temperature, the state of the tropopause, and also the seasonal distribution of temperature and the tropopause. Author

N64-17374 Naval Research Lab., Washington, D.C. Physical Chemistry Branch
INTERCALIBRATION OF THE MAJOR NORTH AMERICAN NETWORKS EMPLOYED IN MONITORING AIRBORNE FISSION PRODUCTS
L. B. Lockhart, Jr. and R. L. Patterson, Jr. 27 Dec. 1963 15 p refs
(NRL 6025; AD-431760)

Simultaneous collections of airborne fission products on filters identical to those used by the major air-monitoring networks presently operating in North America were made by NRL at Washington, D.C., during June 1963. The filters were returned to each of the cooperating agencies for evaluation of their gross radioactivity content. The results were returned for tabulation and evaluation. The relative interconversion factors that are derived from the experimentally determined radioactivity concentrations are as follows: U.S. Public Health Service Radiation Surveillance Network, 1.00; Canadian Radiation Protection Division Network, 1.28; U.S.A.E.C. Health and Safety Laboratory 80th Meridian Network, 1.29; Mexican Radiation Protection Program Network, 1.58; and U.S. Public Health Service National Air Sampling Network, 1.77. The variable associated with the volume of air sampled has been eliminated in this study; the above factors relate solely to the evaluation of the combined effect of filter performance and counting techniques employed by the various networks. Author

N64-17438 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex
APPLICABILITY OF DUAL-PATH SOUND PROPAGATION MEASUREMENTS TO TEMPERATURE DETERMINATION OVER A SIX-MILE PATH
Wendell D. Olsen and Henry J. Leinbach Feb. 1964 61 p refs
(ERDA-112; AD-432009)

An experiment was conducted to determine the characteristics of two-way sound propagation over a 6-mile geodetic line and the applicability of the measurements obtained to acoustic determination of mean temperatures over a long path. The acoustic source generator employed in this experiment consisted of a salute cannon firing 10-gage blank shotgun shells for phases 1 and 2 and a gas jet generator also firing 10-gage shotgun shells for phase 3. Results of the experiment indicate the necessity of favorable meteorological conditions for successful measurement of the sound in both directions; therefore, the method cannot be considered as a reliable day-to-day technique. Author

N64-17468 Army Electronics Research and Development Activity, White Sands Missile Range, N.Mex.
ATMOSPHERIC STRUCTURE, WHITE SANDS MISSILE RANGE, NEW MEXICO. PART 2: TEMPERATURE, RELATIVE HUMIDITY, DEW POINT, STATION PRESSURE, DENSITY, CLOUDS, HYDROMETEORS, AND LITHOMETEORS
Marjorie Mc. Lardie Hoidale Jan. 1964 121 p refs
(ERDA-106; AD-429288)

A statistical analysis of exoteric meteorological data is presented for "A" Station, White Sands Missile Range, New Mexico. Author

N64-17469 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
MONTHLY WIND AND TEMPERATURE DISTRIBUTIONS IN THE FIRST 62 METERS OF THE ATMOSPHERE FOR WHITE SANDS MISSILE RANGE, NEW MEXICO
Frank V. Hansen and Van Dyke Neill Feb. 1964 38 p refs
(ERDA-113; AD-432072)

The data have been analyzed and tabulated at eleven cumulative percentage frequency levels for nine tower observational levels to a height of 62 m above the surface. Author

N64-17504 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
AN ANALYSIS OF AN/FPS-16 RADAR AND AN/GMD-1B RAWINSONDE DATA DIFFERENCES
Roy E. Sandlin, Jr. and Elias M. Armijo Feb. 1964 41 p refs
(ERDA-115; AD-432017)

A series of rawinsonde balloon flights has been tracked simultaneously by AN/GMD-1B rawin and AN/FPS-16 radar. The data acquired have been analyzed for height, wind speed, wind direction, and angular error under field operational conditions. Differences have been tabulated through the first 35,000 ft of the atmosphere and have shown significant AN/GMD-1B errors (under the assumption that AN/FPS-16 data are optimum). Mean error values are shown in order to establish a bias, and rms deviation of error is shown as an indicator of precision of the AN/GMD system. Author

N64-17553 Joint Publications Research Service, Washington, D.C.
FORECASTING JET STREAMS
N. N. Bel'skaya 19 Mar. 1964 17 p refs Transl. into ENGLISH from Tr. Tsentral. Inst. Prognozov (Moscow), no. 125, 1963 p 3–12
(JPRS-23754; OTS-64-21832) OTS: $0.50

The article presents data concerning the accuracy of daily forecasts of the displacement of jet-stream axes. An examination is made of forecasts that have been compiled by means of Ye. P. Borisenkov's method and the method proposed by Reiter in the USA. In studying the applicability and accuracy of these two methods, a more accurate method was obtained, which gives the best results for the territory of Europe. Author

N64-17570 Illinois State Water Survey, Urbana
A DETAILED INVESTIGATION OF AN ILLINOIS HAILSTORM ON AUGUST 8, 1963 Research Report No. 18
Stanley A. Changnon, Jr., and Glenn E. Stout 10 Jan. 1964 35 p refs

All findings and data concerning the hailstorm are presented. These include synoptic weather data, field-survey data, radar data, rainfall data, and crop-loss data. There were two features of this storm that were unusual. The first was that the dameging hail, although not excessive, was produced by an apparently typical airmass, summer thunderstorm. The second unusual feature connected with this hailstorm was the extremely high level of first-echo detection (above 28,000 feet). R.T.K.

N64-17632 Stanford Research Inst., Menlo Park, Calif.
ANALYSIS AND INTERPRETATION OF DAYTIME RADIATION DATA FROM TIROS III, ORBIT 4 Scientific Report 2
William Viezee and Paul A. Davis Jan. 1964 50 p refs
(Contract AF 19(628)-2777)
(AFCRL-64-34; AD-432074)

Radiation patterns analyzed from the listed data of Channels 2, 3, and 5 of TIROS III, Orbit 4, over the United States are compared with the cloud patterns shown on nearly concurrent cloud photographs. It is found that the data from both Channel 3 and Channel 5 can outline accurately all photographed cloud features of a dimension larger than 1° X 1° latitude. Patterns of Channel 5 albedo are related to a nephanalysis from surface observations of cloudiness and precipitation. Areas with only extensive cirriform cloudiness are characterized by low albedos. The highest albedos coincide with areas of precipitating clouds. Author

N64-17633 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
BIBLIOGRAPHY ON SNOW, ICE AND PERMAFROST; WITH ABSTRACTS, VOLUME XVII
Frank M. Marson et al Jun. 1963 274 p refs
(CRREL-12, Vol. 17; AD-432809)

This annotated bibliography provides current and comprehensive coverage of scientific information, both basic and applied, about living and operating in the polar and subpolar regions. The subjects covered vary from ablation to whiteout, and include such diverse topics as avalanche forecasting, ice crystallography, snow mechanics, frost effects, tunneling and excavations, development of trafficable surfaces, permafrost construction, and various phases of heat and mass budgets. R.T.K.

N64-17666 Library of Congress, Washington, D.C. Aerospace Information Div.
PROBLEMS AND METHODS OF THE ABSOLUTE PHOTOMETRY OF NOCTILUCENT CLOUDS [PROBLEMY I METODY ABSOLYUTNOY FOTOMETRII SEREBRISTYKH OBLAKOV]
V. V. Sharonov 28 Jan. 1964 28 p refs Transl. into ENGLISH from the publ. Meteorologiya, no. 1 Moscow, Akad. Nauk SSSR p 124–140
(AID-T-64-7; AD-430526) OTS: $2.60 ph, $1.04 mf

Noctilucent clouds were investigated by photometric methods to obtain optical characteristics of the cloud-forming aerosol, which will permit the formulation of conclusions concerning the chemical composition and physical state of the dispersed particles. Among these characteristics are: (1) the scattering indicatrix, which expresses the directional distribution of the scattered light; (2) variation of the scattering coefficient with wavelength; (3) variation of extinction along the spectrum; (4) polarization of the scattered light; and (5) the character of such luminescence as may exist in the medium. C.L.W.

N64-17690* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INFRASONIC WAVES FROM THE AURORAL ZONE
Kaichi Maeda and Tomiya Watanabe (Brit. Columbia U.) Dec. 1963 42 p refs Presented at the Am. Geophys. Union Ann. Meeting 28 Apr. 1962 Submitted for Publication
(NASA TM X-54620; X-640-63-247) OTS: $4.60 ph, $1.48 mf

Pulsating aurorae are proposed as a source of the infrasonic waves associated with geomagnetic activity reported by Chrzanowski et al. One of the most plausible generation mechanisms of these long-period pressure waves is the periodic heating of the air around 100 km, corresponding to the auroral coruscation reported by Campbell and Rees. In order to show the energetic relationship between source input and pressure change at sea level, some theoretical calculations are performed by using a simple model of auroral distribution in the isothermal atmosphere. Author

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-16913 General Electric Co., Philadelphia Missile and Space Div.
VELOCITY AND POSITION SENSING BY MEANS OF RESONANCE DOPPLER TECHNIQUES
R. Zito, Jr. 11 Oct. 1963 30 p refs
(R63SD314)

The problem of maneuvering and guiding spacecraft during the last steges of docking and mating is considered briefly in the light of the measurement of relative positions and velocities. Accurate determination of speed and separation between space vehicles when distances of 200 feet or less are involved may be accomplished by nuclear detection apparatus. Mossbauer and velocity-swept Mossbauer sensors, inverse square law variation, and atomic resonance methods are discussed. Calculations of performance capabilities and comparisons of relative merits are made for these methods. Some design criteria and description of required instrumentation also are presented. Author

N64-17149 General Electric Co., Johnson City, N.Y.
FAILURE-CORRECTING FLIGHT CONTROL SYSTEM, PHASE I Final Report
B. S. Chamberlain and F. C. Neebe May 1963 91 p
(Contract NOw-62-0622-D)
(Rept. 63APJ13; AD-431748)

A failure-correcting rate controller was designed, and a breadboard model was fabricated and evaluated. The results of a closed-loop evaluation illustrated that automatic failure correction is definitely feasible. It further illustrated that, when introducing or removing a fault, the system can be made to exhibit a minimum control transient. Since triple redundancy yields such large increases in system reliability, the fabrication and flight test evaluation of a flyable three-axis flight control system is recommended. Author

N64-17443 Systems Technology, Inc., Inglewood, Calif.
COMPETING FLIGHT CONTROL SYSTEMS FOR ENTRY GLIDER LATERAL CONTROL
Irving L. Ashkenas and Duane T. Mc Ruer Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Feb. 1964 138 p
(Contract AF 33(616)-5903)
(ASD-TDR-62-699; AD-432190)

Three competing, adaptive, lateral control systems for an entry glider are evolved and compared. In the course of the evolutionary process, entry vehicle dynamic characteristics are examined, and approximate literal transfer functions are determined; some handling qualities requirements are postulated, and competing systems consistent with these requirements are indicated; the systems are formulated and studied using multiloop analysis techniques where appropriate. The systems evolved all include a function of bank angle fed to aileron, $f(\phi) \rightarrow \delta_a$, as an outer-loop. The inner-loops are: $f(r) \rightarrow \delta_r$ (System I), $f(a_y) \rightarrow \delta_r$ (System II), and $f(a_y, r) \rightarrow \delta_r$ (System III). Detailed consideration is given to the functional form of the adaptive adjustments required for equalization and gain. Author

N64-17814 Autonetics, Anaheim, Calif.
A "UNIVERSAL" LINEAR GUIDANCE MECHANIZATION FOR SPACE SYSTEMS
K. C. Kochi 25 Jun. 1963 42 p refs
(TM 243-2-153)

Linear guidance laws are first developed in a general way. Explicit formulations, which are essentially exact first-order representations for impulsive controls, are given for the velocity-to-be-gained. Mechanization of the guidance laws specialized to two-body reference trajectories is considered. An "exact" analytical formulation of the velocity-to-be-gained for any two-body conical reference path is derived. Simplified mechanization to the general elliptic formulations is considered next. In particular, truncated (simplified) expansions of the general elliptic formulations applicable to nearly circular orbits are developed. As a final case, exact formulations for circular orbits are considered. The circular orbit is considered at length, and graphical plots are given for the velocity-to-be-gained sensitivity matrices. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-16917 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
A COVARIANT THEORY OF THE PHOTODISINTEGRATION OF THE DEUTERON-1
M. Le Bellac, F. M. Renard, and J. Tran Thanh Van Feb. 1964 58 p refs

The calculation of the process $\gamma + d \rightarrow n + p$ is made in the framework of a covariant theory. There are 12 invariant amplitudes; they are related to helicity amplitudes and then to multipole amplitudes. A general formula is written explicitly for the calculation of any multipole amplitude from the 12 invariant amplitudes. The Born terms are derived and are then modified in order to take account of deuteron structure; this is done by using n-p-d vertex functions, depending on the transfer. The corresponding cross section is calculated, as well as the 10 dipole and 12 quadrupole amplitudes. It is shown that the octupole terms are not completely negligible for incident photon energies of about 100 Mev. The theory is equivalent in the low-energy limit to the usual nonrelativistic theory based upon Siegert's theorem and excluding final state interactions, but some of the multipole amplitudes seem to be affected by relativistic corrections for energies of order 100 Mev. Author

N64-16923 European Atomic Energy Community, Brussels (Belgium)
THE CRITICAL FACILITY KRITO
J. G. Ackers, M. Bustraan, J. Coehoorn, R. J. Heyboer, F. Luidinga et al (Reactor Centrum Nederland) 1964 34 p refs Presented at the IAEA—Symp. on Exponential and Critical Expt., Amsterdam, 2–6 Sep. 1963 In ENGLISH
(Contract EURATOM 007-61-12 PNIN)
(EUR 498.e) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 50 Belg. Fr.

The zero power reactor KRITO is meant for critical experiments on light-water-moderated power reactors using fuel with low enrichment. The first experimental program is part of the NERO project for the development of a nuclear reactor for ship propulsion. The primary objective is the measurement of reactor physics parameters of the designed NERO core. This design foresees in a power reactor of PWR type, with a two-zone core of UO_2 fuel, canned in zircaloy with enrichments of 3.1% and 3.8% and 12 uniformly distributed control rods of a cadmium–silver–indium alloy. However, for economical reasons, in KRITO use is made of aluminum as canning material and B_4C as poison material; the experiments are done with a constant moderator-to-fuel ratio. A short description of the facility and the experimental program is given. Author

N64-16924 European Atomic Energy Community, Brussels (Belgium)
THE SUBCRITICAL FACILITY PUK
M. Bustraan and A. Tas (Reactor Centrum Nederland) 1964 21 p refs Presented at the IAEA Symp. on Exponential and Critical Expt., Amsterdam, 2–6 Sep. 1963 In ENGLISH
(Contract EURATOM 007-61-12 PNIN)
(EUR 499.e) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 40 Belg. Fr.

A short description is given of the subcritical facility PUK, which has been designed as a complement to the critical facility KRITO. The facility will be placed against the outer reflector of the Argonaut-type reactor, L. F. R., at the reactor center at Petten. To obtain a cylindrical symmetric neutron flux, the core will be rotated around its vertical axis. The facility will be used to measure intracell flux distributions and lattice parameters; to measure the effects on power distribution of watergaps in a lattice and to study methods for preventing flux peaking; and to supply general experimental data for checking calculation techniques. Techniques for measurements of intracell flux distributions in tightly packed lattices and of power distributions near watergaps are described. Attention is given to the calculation of spatial dependent thermal neutron spectra by a modified THERMØS program and to the calculation of power distributions near watergaps. Author

N64-16928 European Atomic Energy Community, Brussels (Belgium)
SOME FEATURES OF FAST AND RELATED REACTORS [QUELQUES CARACTERISTIQUES DE PILES A NEUTRONS RAPIDES ET PILES ASSIMILEES]
Marie-Therese Henry Center for Inform. and Documentation-C.I.D. 1964 43 p refs In FRENCH; ENGLISH Summary
(EUR 549.f) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 60 Belg. Fr.

This survey describes the fast neutron reactors, the fast neutron critical assemblies, the coupled and intermediate reactors that already exist, and those that are under construction or are being planned. For each installation a short description is given of its purpose, main characteristics, and the progress of work. A bibliography is included. Author

N64-16941 Phillips Petroleum Co., Idaho Falls, Idaho Atomic Energy Div.
DOPPLER BROADENING OF THE TOTAL, FISSION, CAPTURE, AND SCATTERING NEUTRON CROSS SECTIONS OF Pu-241
N. H. Marshall and O. D. Simpson AEC Natl. Reactor Testing Sta., 16 Dec. 1963 61 p refs
(Contract AT(10-1)-205)
(IDO-16954) OTS: $1.25

The Doppler distortion of the total, fission, capture, and scattering neutron cross sections obtained from the multilevel analysis of the total neutron cross section of Pu-241 are presented. The extent of the Doppler distortion of the resonances below 11 ev at temperatures ranging from 0° to 3,000°C has been studied. Tables of cross sections versus neutron energy for different sample temperatures are given. Author

N64-16960 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEWS FROM SCIENCE AND TECHNOLOGY
23 Jul 1963 6 p Transl. into ENGLISH from Fiz. v Shkole (USSR), no. 1, 1957 p 32–33
(FTD-TT-63-674/1; AD-414981)

This news review discusses the following: (1) Investigations of the properties of steels at ultrahigh pressures, considerably exceeding 1,000 atm, revealed that these pressures increase the plasticity and tensility of steel. These properties can be utilized when drawing steel wire. (2) Investigations were aimed at compressing a gas at ultrahigh pressures so that the gas becomes solid crystals without going through the liquid stage. (3) Investigations were conducted of the properties of water flowing out at pressures of 1,500 atm. This water has the properties of a cutting tool. (4) Use in ramjets of the energy of the atomic oxygen of the upper layers of the atmosphere was investigated. The ramjets would suck in air containing atomic oxygen. Nitric oxide, acting as a catalyst, would be added to the air in the engine. This would result in the atoms combining into molecules and liberating energy, which would lead to a sharp heating and very high activity of the gas stream. Also, the use of rockets for investigating the upper atmospheric layers during the IGY is discussed. I.v.L.

N64-16969 California U., Berkeley Inst. of Engineering Research
DRAG OF A TWO DIMENSIONAL STRIP NORMAL TO HYPERSONIC NEAR FREE MOLECULE FLOW
Denny Ru-sue Ko 30 Jan. 1964 73 p refs
(Contract Nonr-222(45))
(AS-64-4; AD-431773)

Drag coefficients for two-dimensional strips normal to the flow have been determined experimentally at Mach numbers of 6.22, 8.12, and 10.09, by means of the free-jet testing technique. The free-stream Knudsen number ranges from about 1 to 30. Results obtained are compared to the nearly free-molecule flow theory proposed by Willis. Special tests were performed to demonstrate the validity of the free-jet experimental technique and to determine the feasibility of further application of this valuable testing method. Author

N64-16983 Columbia U., New York, N.Y. Columbia Radiation Lab.
RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Fourth Quarterly Progress Report, 16 Sep.–15 Dec. 1963
R. Novick 15 Dec. 1963 73 p refs
(Contract DA-36-039-SC-90789)
(AD-430979)

Direct evidence has been obtained for the two-photon decay of the metastable state of the helium ion. Coincident counts have been obtained between vacuum ultraviolet photon detectors that are exposed to a beam of metastable helium ions. These coincidences are removed when the metastable ions are quenched with a suitable RF electric field. Double-resonance and level-crossing studies of the excited states of the chromium atom are continuing. The metastable autoionizing lithium atom may be partially quenched with a magnetic field of several thousand gauss. Theoretical studies are continuing on laser quenching of metastable atoms. Further results have been obtained on the motional broadening of Rayleigh scattered light. An oscillation parameter of greater than unity has been obtained with a pulsed optically pumped rubidium hyperfine maser. Studies of the microwave properties of model planetary atmospheres are continuing, and a model of the Venusian atmosphere has been constructed that is consistent with all available data. Author

N64-16995 General Electric Co., Cincinnati, Ohio
HIGH-TEMPERATURE MATERIALS AND REACTOR COMPONENT DEVELOPMENT PROGRAMS. VOLUME I: MATERIALS Third Annual Report, 1 Jan. 1963–31 Jan. 1964

28 Feb. 1964 161 refs
(Contract AT(40-1)-2847)
(GEMP-270A) OTS: $2.75

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1. HIGH-TEMPERATURE REACTOR MATERIALS FABRICATION RESEARCH p 15–45 refs (See N64-16996 09-18)
2. EFFECT OF RADIATION ON HIGH-TEMPERATURE REFRACTORY METALS AND ALLOYS p 45–104 refs (See N64-16997 09-18)
3. RADIATION EFFECTS IN BeO p 105–136 refs (See N64-16998 09-23)
4. FISSION GAS DIFFUSION IN UNFUELED CERAMIC MATERIALS p 137–140 refs (See N64-16999 09-23)
5. FISSION PRODUCT TRANSPORT PROCESSES IN REFRACTORY-METAL FUEL SYSTEMS p 141–144 refs (See N64-17000 09-23)
6. INTERNAL CONVERSION CERAMIC FUEL ELEMENT RESEARCH p 145–154 refs (See N64-17001 09-23)
7. APPENDIX: REPORTS ISSUED DURING CALENDAR YEAR 1963 p 155–159 refs

N64-16998 General Electric Co., Cincinnati, Ohio
RADIATION EFFECTS IN BeO
In its High-temp. Mater. and Reactor Component Develop. Programs Vol. I: Materials 28 Feb. 1964 p 105–136 refs (See N64-16995 09-23) OTS: $2.75

Expansion is the principal effect of irradiation in BeO. In low-temperature (~ 100° C) irradiations, the expansion in specimens of 3μ to 20μ grain sizes occurs at a rate of 0.2 to 0.3 percent $\Delta V/V$ per 10^{20} nvt ($\geq$1 Mev) up to about 1.7×10^{20} nvt, and then increases to a rate of approximately 1 percent $\Delta V/V$ per 10^{20} nvt. It consists of volume components from lattice expansion and from cracks which form at grain boundaries as a result of greater expansion in the crystallographic c-axis than in the a-axis. The expansion due to grain-boundary cracks increases with increasing dosage and is 2 to 3 times as large as that from lattice expansion at dosages from approximately 4 to 10×10^{20} nvt. Author

N64-16999 General Electric Co., Cincinnati, Ohio
FISSION GAS DIFFUSION IN UNFUELED CERAMIC MATERIALS
In its High-temp. Mater. and Reactor Component Develop. Programs Vol. I: Materials 28 Feb. 1964 p 137–140 refs (See N64-16995 09-23) OTS: $2.75

Preliminary results of the diffusion coefficient and activation energy are not necessarily characteristic of krypton diffusion in the majority of the oxides considered because of nonuniform beam intensity, variations in beam energy, and, possibly, because of a rough specimen surface. For these reasons, it is highly probable that the diffusion coefficient was overestimated and also that surface barrier effects were reflected in activation energy results. Procedures were adapted to improve the quality of the ion beam and the target surface and to separate volume and surface effects. An improved ion gun was fabricated. Preliminary testing indicates the achievement of magnetic field strengths as high as 210 gausses at the end of the anode spool, without overheating, and a magnetic field that is a linear function of the coil current. Calibration of pressure manometers was also completed to pressures above 10^{-5} torr. Author

N64-17000 General Electric Co., Cincinnati, Ohio
FISSION PRODUCT TRANSPORT PROCESSES IN REFRACTORY-METAL FUEL SYSTEMS
In its High-temp. Mater. and Reactor Component Develop. Programs Vol. I: Materials 28 Feb. 1964 p 141–144 refs (See N64-16995 09-23) OTS: $2.75

As a result of a literature survey of other noble gas–metal diffusion couples, a glow-discharge technique is being used to introduce Kr into refractory metals for the study of the diffusion of fission gas. A permeation technique is also being developed to supplement the basic diffusion studies. Arc-cast Ta was chosen for the initial diffusion and permeation work. The necessary equipment was constructed to maintain the purity of the sample in order to avoid as many indefinable variables as possible. Author

N64-17001 General Electric Co., Cincinnati, Ohio
INTERNAL CONVERSION CERAMIC FUEL ELEMENT RESEARCH
In its High-temp. Mater. and Reactor Component Develop. Programs Vol. I: Materials 28 Feb. 1964 p 145–154 refs (See N64-16995 09-23) OTS: $2.75

Three component UO_2-ThO_2-Y_2O_3 fuels were found to be susceptible to silica contamination from Y_2O_3-stabilized ZrO_2 furnace refractories during reaction at 1,850° C in air. Uncontaminated fuel additives, suitable for fuel retention studies, were prepared by reacting in the same refractories at 1,675° C for periods in excess of 30 hrs, or by substituting high-purity BeO furnace refractories for the Y_2O_3-stabilized ZrO_2 refractories and reacting for 1 hr at 1,850° C. These reaction methods have not resulted in the desired well-crystallized material for the phase relationship studies. A fuel retention test of BeO specimens fueled with F-229 (UO_2-ThO_2-Y_2O_3 mole ratio of 1:2:0.55) conducted for 300 hrs at 1,500° C in air showed essentially the same fuel loss from contaminated and uncontaminated fuel additives. Vapor pressures of the F-227 and F-231 compositions (UO_2-ThO_2-Y_2O_3 mole ratios of 1:1:0.55 and 1:4:0.55, respectively) are approximately the same as a UO_2-Y_2O_3 composition with a mole ratio of 1:0.55, indicating that the vapor pressure of UO_3 over UO_2-ThO_2-Y_2O_3 compositions is independent of the ThO_2 content. Author

N64-17002 Queen's U., Belfast (Northern Ireland)
RESEARCH ON PHYSICS OF THE UPPER ATMOSPHERE
Final Report
D. R. Bates, A. Dalgarno, A. H. Jarrett, B. L. Moiseiwitsch, A. L. Stewart et al 30 Jun. 1963 73 p refs
(AF EOAR Grant 62-118)
(AFCRL-64-216; AD-430918)

CONTENTS:

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1. DIURNAL VARIATION OF THE TEMPERATURE OF THE THERMOSPHERE p 2–9 refs (See N64-17003 09-12)
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3. DETERMINATION OF THE TEMPERATURE OF THE UPPER ATMOSPHERE FROM THE PROFILES OF NIGHT-GLOW EMISSIONS USING A FABRY-PEROT SCANNING INTERFEROMETER p 14–18 refs (See N64-17005 09-12)
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7. PHOTOIONIZATION CROSS-SECTION OF MOLECULAR HYDROGEN p 31–32 refs (See N64-17009 09-23)
8. TWO-ELECTRON SYSTEMS p 34–36 ref (See N64-17010 09-23)
9. THREE ELECTRON SYSTEMS p 37–44 refs (See N64-17011 09-23)
10. THE CALCULATION OF SECOND ORDER DISTURBANCES p 45–58 refs (See N64-17012 09-23)

N64-17006 Queen's U., Belfast (Northern Ireland)
VARIATIONS OF HYDROXYL AND OXYGEN EMISSIONS IN THE INFRA-RED AIRGLOW
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 19–21 refs (See N64-17002 09-23)

In order to obtain good spectroscopic resolution of the variations of the infrared airglow, the construction of an Ebert-type spectrograph was undertaken. The main emphasis was placed on the light-gathering power of the instrument. This instrument had reached a reasonable state of completion when preliminary tests showed that considerable modifications had to be made. Author

N64-17008 Queen's U., Belfast (Northern Ireland)
CALCULATION OF SCATTERING CROSS-SECTIONS USING THE FIRST AND SECOND BORN APPROXIMATION
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 25–30 refs (See N64-17002 09-23)

The second Born approximation is used to calculate the cross sections for the excitation of the 2p states of atomic hydrogen by electron, positron, and proton impact, with allowance for virtual transitions via the 1s, 2s, and 2p intermediate states. Author

N64-17009 Queen's U., Belfast (Northern Ireland)
PHOTOIONIZATION CROSS-SECTION OF MOLECULAR HYDROGEN
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 31–32 refs (See N64-17002 09-23)

Calculations have begun on the photoionization cross section of molecular hydrogen. Author

N64-17010 Queen's U., Belfast (Northern Ireland)
TWO ELECTRON SYSTEMS
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 34–36 ref (See N64-17002 09-23)

The method of superposition of configurations is used to determine the contributions from radial and angular correlation to the second-order term in the expansion of the energies of excited states of the two-electron systems in inverse powers of the nuclear charge. Author

N64-17011 Queen's U., Belfast (Northern Ireland)
THREE ELECTRON SYSTEMS
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 37–44 refs (See N64-17002 09-23)

Open-shell analytical wave functions have been calculated for the $1S^2nf^2P$, n = 2,3,4 states of the three-electron systems, and are used to calculate properties such as the hyperfine splitting, the isotope shift, and the dipole polarizability. Satisfactory agreement with experiment is obtained. Author

N64-17012 Queen's U., Belfast (Northern Ireland)
THE CALCULATION OF SECOND ORDER DISTURBANCES
In its Res. on Phys. of the Upper Atmosphere 30 Jun. 1963 p 45–58 refs (See N64-17002 09-23)

The method of Dalgarno for the calculation of dipole and quadrupole polarizabilities and shielding factors is developed for four-electron systems in the configuration $1s^2\ 2s^2$. Results are given for the systems Be, B+, and C++. Author

N64-17025 Duke U., Durham, N.C.
OPERATOR STRUCTURES IN SU_3 WITH AN APPLICATION TO TRIPLETS
G. E. Baird and L. C. Biedenharn [1964] 14 p refs Presented at the Conf. on Symmetry Principles at High Energy, Miami U., 30 Jan. 1964
(Supported in part by Army Res. Office and NSF)

General results for the currently interesting SU_3 group ("the eightfold way" of Gell-Mann and Ne'eman) that have been obtained for the unitary groups SU_n, as a whole, are summarized for the purpose of indicating which results are now available for carrying out specific applications to problems of physical interest. A byproduct of the investigation, which led to these results, is the concept of triality for SU_3 representations. Application of this concept is employed to show that the existence of triplet (SU_3) representations need not require the introduction of fractional charge, nor of fractional baryon or strangeness quantum numbers. This is in contrast to the situation for Gell-Mann's "quarks," and thus provides an attractive alternative formulation for the SU_3 triplets. I.v.L.

N64-17042 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONCERNING THE THEORY OF SLOW-NEUTRON SCATTERING IN ALLOYS
V. M. Danilenko, M. A. Krivoglaz, Z. A. Matysina, and A. S. Smirnov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 263–279 refs (See N64-17026 09-18)

Formulas are deduced both for the probability of neutron scattering, associated with the disturbance of the regular alternation of atoms of various kinds at the crystal lattice points, and for magnetic dispersion. The general case of a multicomponent alloy, which in an ordered state has any number of lattice-point types, is considered, and the correlation between the filling of lattice points by atoms in all coordination spheres is taken into account. The following cases are considered in particular: (1) deriving a general formula for the probability of nuclear scattering of slow neutrons by alloys; (2) study of the dependence of slow-neutron scattering intensity on the alloy composition, on long-range-order parameters, on correlation parameters, and on the angle of scattering in particular cases—binary alloys (background intensity of scattered slow neutrons disregarding correlation, background intensity of scattered slow neutrons with correlation), and ternary alloys; and (3) magnetic scattering of neutrons in the circuit of the Curie point of ferromagnetic materials. P.V.E.

N64-17051 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
$L\beta_6$ AND $L\gamma_5$ LINES IN THE SPECTRA OF COPPER AND ZINC
M. I. Korsunskiy and I. A. Rumyantsev *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 424–429 refs (See N64-17026 09-18)

The lines discovered in the copper and zinc spectra are lines L_{β_6} and L_{γ_5} and relate to the transitions L_{III}–N_I and L_{III}– –N_I. The distances of these lines from $L_{\alpha_{1,2}}$ and L_{β_1} were measured. Author

N64-17052 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INFLUENCE OF THE CONCENTRATION OF COMPONENTS IN IRON–CHROMIUM ALLOYS ON THE STRUCTURE OF THE ENERGY SPECTRUM OF THE CHROMIUM AND IRON CONDUCTIVITY ZONE AT HIGH TEMPERATURES

N. D. Borisov, V. V. Nemoshkalenko, and A. M. Fefer *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 430–446 refs (See N64-17026 09-18)

An investigation of the $K_{\beta 5}$ lines of chromium and iron and $K_{\beta 1}$ lines of the same elements is discussed. It was found that: (1) The transition of chromium and iron into an iron–chromium alloy within the range of concentration studied and of the γ-phase into the α-solid solution have no effect on the position of the maxima of the $FeK_{\beta 1}$, $FeK_{\beta 5}$, and $CrK_{\beta 1}$ lines, within the limits of errors in measurement. (2) The position of the maximum of the $CrK_{\beta 5}$ band is displaced toward the long waves as the concentration of iron in iron–chromium alloys increases. (3) The breadth of the conductivity band and the number n of "outer" electrons per atom, in all cases examined, are different for chromium and iron, decreasing for iron with a greater chromium concentration in iron–chromium alloys and, conversely, increasing for chromium with a greater concentration of iron. (4) There existed a linear dependence on the concentration of the components in iron–chromium alloys of the value for T_{max} (the kinetic energy of electrons) and for the number n the "outer" electrons per atom in the conductivity band of chromium and iron. P.V.E.

N64-17055 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

X-RAY SPECTROSCOPIC STUDIES OF FERRO-MOLYBDENUM AND FERRO-ALUMINUM ALLOYS

S. A. Nemnonov, V. A. Trapeznikov, and K. M. Kolobova *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 470–490 refs (See N64-17026 09-18)

A study of K-absorption spectra and emission spectra for iron contained in ferromolybdenum alloys (0%, 0.5%, 1.0%, 2.0%, 4.0%, 10.0%, 15.0%, 25.0%, 46%, and 52% Mo) and the ferroaluminum alloys of stoichiometric composition Fe_3Al, FeAl, and $FeAl_3$ is summarized. P.V.E.

N64-17057 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ON THE POSSIBILITY OF RADIOAUTOGRAPHIC DETECTION OF INHOMOGENEITIES IN CONCENTRATIONS OF ADSORPTION ORIGIN

V. I. Arkharov et al *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 498–510 refs (See N64-17026 09-18)

An investigation carried out to confirm existing data on the adsorptive activity of certain small admixtures in alloys based on copper and aluminum is discussed. Also discussed is an attempt to calculate theoretically the distribution of β-radiation on the surface of the various specimens (50-micron plates), taking into account its adsorption through repeated scattering. P.V.E.

N64-17075 California U., Livermore. Lawrence Radiation Lab.

X-RAY MICROGRAPHY OF ALPHA PLUTONIUM

E. M. Cramer 15 Jan. 1964 18 p refs
(Contract W-7405-ENG-48)
(UCRL-7651) OTS: $0.50

A simple Berg–Barrett X-ray camera was adapted to study grains in alpha plutonium. Grains that can be observed by optical means consist of numerous subgrains, generally less than 10 μ in width, that appear to be disoriented by angular differences of more than 1°. Limitations of the camera with regard to resolution and measurement of angles are presented. Author

N64-17107 Argonne National Lab., Ill.

RADIOLOGICAL PHYSICS DIVISION SUMMARY REPORT, JULY 1962–JUNE 1963

J. E. Rose and L. D. Marinelli Dec. 1963 248 p refs
(Contract W-31-109-ENG-38)
(ANL-6769) OTS: $3.00

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2. DIFFUSION AND ABSORPTION OF GASES IN PLASTIC-WALLED IONIZATION CHAMBERS J. H. Marshall, R. J. Lari, and Jacob Kastner p 21–33 refs (See N64-17109 09-23)

3. MEASUREMENT OF THE COSMIC-RAY NEUTRON BACKGROUND Jacob Kastner, B. G. Oltman, and L. D. Marinelli p 34–54 refs (See N64-17110 09-28)

4. SCINTILLATIONS IN ARGON AND NITROGEN Harvey A. Schultz p 55–179 refs (See N64-17111 09-23)

5. A NOTE ON ELLIPSOIDAL WIND DISTRIBUTIONS Harold L. Crutcher and Harry Moses p 181–196 refs (See N64-17112 09-21)

6. AN EVALUATION OF WIND PROFILE LAWS BY LEAST SQUARES TECHNIQUES J. Robert Stinson, Harry Moses, and John E. Pearson p 197–219 refs (See N64-17113 09-21)

7. MAN-MADE IONIZED COLUMNS IN THE ATMOSPHERE—A NEW TOOL FOR METEOROLOGICAL RESEARCH Harry Moses, Ronald L. Martin, Jacob Kastner, and A. J. Ulrich p 220–229 refs (See N64-17114 09-21)

N64-17108 Argonne National Lab., Ill.

MOMENTS OF THE OSCILLATOR STRENGTH DISTRIBUTION AND SOME ASSOCIATED QUANTITIES FOR THE HYDROGEN ATOM

Mitio Inokuti *In its* Radiological Phys. Div. Summary Rept., Jul. 1962–Jun. 1963 Dec. 1963 p 7–19 refs (See N64-17107 09-23) OTS: $3.00

Numerous properties of an atomic or molecular system can be expressed in terms of the oscillator-strength distribution characteristic of the system. At the present time, the hydrogen atom is the only system whose oscillator-strength distribution is rigorously known. In this respect, a systematic tabulation is presented of the moments of the oscillator-strength distribution and some associated quantities for this case of the simplest atomic system. The cross section for excitation and ionization of an atomic or molecular system, by impact of a fast charged particle, has a close connection with the corresponding oscillator strength. In fact, the Bethe asymptotic expression for the cross section at high incident energies involves the oscillator strength and another constant associated with the final state of the system. A tabulation of the latter constants for the hydrogen atom is presented. The present tabulations (calculations) are helpful, not only for a detailed application of the Bethe collision theory, but also as an orientation in the study of the oscillator-strength distributions of more complicated atomic and molecular systems. I.v.L.

N64-17109 Argonne National Lab., Ill.

DIFFUSION AND ABSORPTION OF GASES IN PLASTIC-WALLED IONIZATION CHAMBERS

J. H. Marshall, R. J. Lari, Jacob Kastner, and T. Prevender *In its* Radiological Phys. Div. Summary Rept., Jul. 1962–Jun. 1963 Dec. 1963 p 21–33 refs Submitted for publication (See N64-17107 09-23) OTS: $3.00

In the design of stable, tissue-equivalent ionization chambers, the important factors are the solubility and permeability of the wall materials to the contained gases. Diffusion measurements for N_2, O_2, He, CO_2, CH_4, C_2H_6, C_2H_4, and Ne have been carried out on thin discs of a variety of tissue-simulating plastics. The data are used for the determination of the equilibrium times and pressure changes to be expected for typical large, thick-walled ion chambers. Author

N64-17111 Argonne National Lab., Ill.
SCINTILLATIONS IN ARGON AND NITROGEN
Harvey A. Schultz *In its* Radiological Phys. Div. Summary Rept., Jul. 1962–Jun. 1963 Dec. 1963 p 55–179 refs (See N64-17107 09-23) OTS: $3.00

The gaseous scintillations in argon, nitrogen, and mixtures of both gases were investigated to obtain a more complete understanding of the energy transfer processes in these pure gases and mixtures when bombarded with alpha particles. The pulse height of the gases and mixtures decreased with increasing pressure above 4 atm, which is consistent with theoretical expectations whenever collisions cause a deexcitation of molecules, but the decrease may also depend upon the variation of light collection efficiency with track length. Below 4 atm the pulse height spectra were distorted because of impacts of alpha particles with the walls. Generally speaking, the pulse height in the mixtures decreased with increased nitrogen concentration. This effect is consistent with the following hypotheses: (1) Both nitrogen and argon, in the pure state, produce detectable light. (2) The detectable emission process of argon is quenched by nitrogen. (3) Argon is excited by alpha particles to levels that do not produce detectable light emission. (4) The energy of these argon levels, however, can be transferred to nitrogen, which then produces detectable light. I.v.L.

N64-17117 Southampton U. (Gt. Brit.)
RESEARCH IN BOUNDARY LAYER OSCILLATIONS AND NOISE Technical Documentary Report [Mar. 1960-Mar. 1962]
M. K. Bull and J. L. Willis Wright-Patterson AFB, Ohio, Res. and Technol. Div., Feb. 1964 58 p refs
(Contract AF 61(052)-358)
(RTD-TDR-63-4012; AD-431190)

Experimental data are presented on the rms levels, frequency spectra, probability distributions, and space–time correlations of the pressure field as a whole, and in narrow frequency bands, for turbulent layers on smooth surfaces. General qualitative effect of a surface discontinuity on the rms pressure and frequency spectrum are given. An empirical representation of the space–time correlation pattern of the pressure field is developed for the purposes of structural response calculations. A general program for the study of a mechanism of boundary-layer turbulence is presented along with a discussion of the testing and analyzing instrumentation. An analytical method is presented for the prediction of the power spectral density of panel response to boundary-layer and siren excitation. An empirical equation is developed relating the acoustic power output from a unit area of a (large) surface subject to turbulent boundary-layer flow to the aerodynamic flow parameters.
Author

N64-17127 National Bureau of Standards, Washington, D.C.
TABLES OF THERMODYNAMIC PROPERTIES OF NITROGEN IN CHEMICAL EQUILIBRIUM INCLUDING SECOND VIRIAL CORRECTIONS FROM 2000° K to 15,000° K
Joseph Hilsenrath and Max Klein Arnold AF Sta., Tenn., Arnold Eng. Develop. Center, Mar. 1964 169 p refs
(Contract AF 40(600)60-127; Contract AF 40(600)63-136)
(AEDC-TDR-63-162; AD-432210)

Tables for the thermodynamic properties for nitrogen are presented that take into account the effect of dissociation and ionization and the limiting-law Debye–Huckel and second virial corrections, upon the thermodynamic properties and the equilibrium compositions. Values are tabluated from 2,000° K in steps of 100° to 15,000° K at close spacings in the logarithm of the density [$\log_{10}\rho/\rho_o = -7.0\ (0.2)\ 2.4$] for the compressibility factor $Z = PV/RT$; the imensionless functions for: internal energy, E/RT; enthalpy, H/RT; entropy, S/R; $\log_{10} P$ (atm) and $Z^* = \Sigma C_i$. The underlying equations and the input data are discussed briefly. The effects of the real gas corrections on the equilibrium properties are illustrated graphically. The equilibrium composition is given for selected temperatures over the tabulated density range. Author

N64-17153* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
THE DESIGN OF MICROMETEOROID PENETRATION EXPERIMENTS AS SINGLE-SAMPLING LIFE-TEST SAMPLING PLANS
Arthur G. Holms Washington, NASA, Mar. 1964 33 p refs (NASA TN D-1989) OTS: $0.75

The danger of penetration of a vulnerable part of a space vehicle is assumed to be measured by the product of the exposed vulnerable area and the time that the mission will occupy a region of space containing micrometeoroids. The size of the sample is considered to be the factor by which the total sum of area-time products of the experiments exceeds the mission vehicle area-time product. Single binomial sampling plans are presented that cover a wide range of values of the quantities of interest. Procedures are suggested for data analysis following experimentation. Sampling plans adequate for decisions where low reliability can be tolerated were found to involve experiment area-time products of 10 to 50 times the mission vehicle area-time product. Minimum sampling plans adequate for manned vehicle reliabilities were found to require experiment area-time products 700 to 7,000 times the mission vehicle area-time product. Author

N64-17179 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
UKRAINIAN JOURNAL OF PHYSICS (SELECTED ARTICLES)
4 Apr. 1963 18 p refs Transl. into ENGLISH of 3 articles from Ukr. Fiz. Zh. (Kiev), v. 7, no. 1, 1962 p 73–74, 79–81, 83–86
(FTD-TT-63-88/1+2; AD-402587)

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N64-17180 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

OBTAINMENT OF ULTRAHIGH VACUUM WITH THE AID OF CHROMIUM, DISPERSED BY ELECTRON BOMBARDMENT

G. S. Mikhaylov, G. M. Presnyakova, and O. M. Akimovich *In its* Ukr. J. of Phys. (Selected Articles) 4 Apr. 1963 p 1-3 refs (See N64-17179 09-23)

An investigation into the vacating effect of electron-bombarded chromium in an ultrahigh vacuum ($p < 5 \times 10^{-8}$ mm Hg) is discussed. During the dispersion of Cr by electron bombardment, a vacuum of 2 to 5×10^{-9} mm Hg was easily obtained, and, with an oil pump alone, the vacuum amounted to 2×10^{-6} mm Hg. Measurement of the rate of air vacating (pumping) by Cr produced a value of $\sim 5 \times 10^{2}$ liters/sec at a vacuum of 2×10^{-9} mm Hg. At pressures of $5 \times 10^{-10} \leq p \leq 5 \times 10^{-8}$ there was observed, at the time of the dispersion of Cr by electron bombardment, concentrations of filiform and chromium oxide Cr_2O_3 crystallites similar to them. These filiforms were not destroyed by the electron bombardment or the high temperature of the experiment. P.V.E.

N64-17181 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CERTAIN CHARACTERISTICS OF PARTIAL ADSORPTION OF COMPONENTS OF RESIDUAL GASES AT VERY HIGH VACUUM. II.

Yu. G. Ptushinskiy and B. O. Chuykov *In its* Ukr. J. of Phys. (Selected Articles) 4 Apr. 1963 p 4-8 refs (See N64-17179 09-23)

The flash method of investigating the kinetics of gas adsorption was used in conjunction with the mass-spectrometric method. Data were obtained on the kinetics of adsorption of components of residual gases and on temperature stability of components of residual gas film adsorbed on the surface of tungsten. R.T.K.

N64-17195 Syracuse U., N.Y.

ELECTRO MAGNETICS AND ANTENNAS

Roger F. Harrington *In* Md. U. Proc. of the Space Communications Inst., Md. U., College Park, Jun. 23-28, 1963 1963 p 4-14 refs (See N64-17194 09-08) OTS: $9.10 ph, $3.50 mf

Fundamentals of electromagnetics include: (1) Maxwell's equations as they apply in a vacuum; (2) the derivation of a one-dimensional wave equation for the case in which an electric field has only one component—for example, an x component—and is a function only of time and z perpendicular to x; (3) wavelength; (4) wave number; (5) a uniform plane wave; (6) linearly, circularly, and elliptically polarized waves; (7) a standing-wave pattern; (8) waveguides; and (9) wave sources. Fundamentals of antennas include: (1) the input impedance and efficiency of antennas; (2) antenna gain, bandwidth, and sidelobe level; (3) electric and magnetic dipoles; (4) normal-gain antenna; (5) supergain antenna; and (6) antenna arrays. I.v.L.

N64-17207 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Atomic Energy Research Establishment

EQUIPMENT FOR THE INVESTIGATION OF THE EMISSION OF FISSION PRODUCTS FROM IRRADIATED CERAMIC FUELS

D. Davies and G. Long Jul. 1963 34 p refs

(AERE-R-4322) Available from HMSO: 4s 6d

The equipment and experimental procedure used to investigate the emission at temperatures up to 2,200° C of fission products from lightly irradiated samples of ceramic fuel materials are described. Important criteria in the design of the equipment and methods of interpreting the data are discussed. Author

N64-17222* Radio Corp. of America, Princeton, N.J. RCA Labs.

VAPOR-FILLED THERMIONIC CONVERTERS Final Report

K. G. Hernqvist, J. R. Fendley, H. Hendel, and J. D. Levine Dec. 1963 55 p refs

(NASA Contract NAS3-2531)

(NASA CR-54009) OTS: $5.60 ph, $1.85 mf

Electron emission S-curves are computer-calculated by means of the Levine-Gyftopoulos adsorption theory, using no adjustable parameters. Predictions are made for cesium on various crystal faces and on 21 transition metals. A simplified appropriate treatment of adsorption theory is given. It is shown that a new dimensionless parameter characterizes, to a first approximation, electron-emission S-curve performance for different adsorbates, substrates, and arrival dates. A recently initiated study of cesium adsorption on insulators has been carried out both theoretically and experimentally. Among other things, it is discovered that the cesium is adsorbed on an insulator as a molecular ion with a binding energy of 1.65 ev. An analysis of the cesium vapor arc discharge is presented. Apparatus is described that permits continuous pumping of cesium vapor devices. Using this apparatus, the outgassing from an operating cesium diode has been analyzed, and typical results are presented. Experimental data on the results of dosing an arc mode cesium diode with xenon and krypton are given, and a discussion of these results is included. Finally, a study is made that predicts the effect of nuclear reactor radiation on a cesium diode dosed with xenon gas. Author

N64-17232 Argonne National Lab., Ill.

NUCLEAR SPECTROSCOPY WITH DIRECT REACTIONS. I: CONTRIBUTED PAPERS

F. E. Throw, ed. Mar. 1964 259 p refs For Presentation at the Symp. on Nuclear Spectry. with Direction Reactions, Chicago, 9-11 Mar. 1964

(Contract W-31-109-ENG-38)

(ANL-6848) OTS: $3.00

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34. A STUDY OF THE NUCLEAR REACTIONS $Mg^{26}(p,t)Mg^{24}$ AND $Mg^{26}(He^4, He^6)Mg^{24}$ M. E. Rickey, H. E. Wegner, K. W. Jones (Brookhaven Natl. Lab.), B. M. Bardin, C. Hoot, and M. Kondo (Colo. U.) p 217–225 refs

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40. THEORY OF INTERMEDIATE STRUCTURE J. E. Young (Los Alamos Lab.) p 241–248 refs

N64-17238 Los Alamos Scientific Lab., N. Mex.
EXPERIMENTAL STUDIES RELATING TO ROTATING FLUIDIZED BED REACTORS
H. P. Deinken, A. C. Juveland, and J. E. Dougherty 26 Feb. 1964 40 p refs
(Contract W-7405-ENG-36)
(LAMS-3012) OTS: $1.00

A summary is presented of work on the mechanical properties of fluid beds. This information, in addition to that previously reported on heat transfer and material losses from fluid beds, is used to discuss a rotating fluidized bed reactor. Research on minimum fluidization, a 360° rotating fluidized bed, beds at normal gravity condition, and agglomeration is reported. R.T.K.

N64-17239 Los Alamos Scientific Lab., N.Mex.
SOME LOW ENERGY NEUTRINO CROSS SECTIONS
Leon Heller 17 Mar. 1964 61 p refs
(Contract W-7405-ENG-36)
(LAMS-3013) OTS: $1.50

The cross sections for elastic neutrino and antineutrino scattering on electrons, and antineutrino absorption on protons (giving a neutron and a positron) are calculated using the V-A four-fermion interaction. Recoil electron spectra are presented for the elastic scatterings, and the angular distribution of positrons is given for the absorption process, in addition to total cross sections for all these processes. Results are given analytically and in graphical form. The steps necessary to perform these calculations are explained in detail. Author

N64-17261 Rochester U., N.Y.
QUASIFREE PROTON-DEUTERON SCATTERING CORRECTIONS NEAR 210 MeV
P. F. M. Koehler, E. H. Thorndike, and Alan H. Cromer (Northeastern U.) 21 Jan. 1964 12 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-21)

The results of the impulse approximation formalism of Cromer are applied to proton–deuteron inelastic scattering near 210 Mev to obtain corrections relating measured quasi-free P_{pp}, P_{np}, and D_{np} data to the respective free parameters. Author

N64-17266 Oak Ridge National Lab., Tenn.
THE ANGULAR AND SPECTRAL DISTRIBUTIONS OF LIGHT EMITTED FROM ELECTRON-BOMBARDED SILVER FOILS
Norma O. Davis, E. T. Arakawa, L. C. Emerson, and R. D. Birkhoff (M.S. Thesis—Vanderbilt U.) Mar. 1964 72 p refs
(Contract W-7405-ENG-48)
(ORNL-3485) OTS: $1.75

The spectral distribution of photons emitted by Ag foils 660 A and 1,980 A in thickness bombarded by 40-kev electrons has been determined experimentally in the wavelength region from 2,500 A to 5,600 A. The spectra were determined for photons emitted at 0° to 150° from the foil normal using an angular distribution chamber, which permitted the spectrometer to be rotated around the foil in a continuous fashion without breaking the vacuum. A Glan prism analyzer was used to separate the light into a component polarized parallel to the plane of the electron and photon and another component perpendicular to it. Transition radiation is polarized in the parallel plane, whereas bremsstrahlung has both a parallel and perpendicular component. The photon in the perpendicular plane was found to be about 10% of that in the parallel plane. The spectrum in the parallel plane showed a sharp peak at 3,300 A, this value being an average over photon directions from 10° to 50° from the foil normal. This agrees with the theoretical predictions and is within the limits of error of previous determinations at 30° Author

N64-17277 Adelphi Research Center, Mineola, N.Y.
STRUCTURE-BORNE NOISE AND RELATED FIELDS OF INTEREST: RECENT WORK AND PROBLEM AREAS
Frederick V. Pohle Jul. 1963 75 p refs
(Contract Nonr-3554(01))
(AGM-109; AD-429781)

This annotated bibliography outlines recent unclassified results and problem areas in the field of structureborne noise and related disciplines. In addition to recent books and review articles, the following subjects are covered: dynamics, hydrodynamics, elasticity theory, structures, plates and shells, damping, random effects, acoustics, sound fields, and numerical methods. R.T.K.

N64-17290 Atomics International, Canoga Park, Calif.
ANALYSIS OF NEUTRON SCATTERING FROM SMALL VOLUMES OF CARBON, BERYLLIUM, ALUMINUM, IRON, AND POLYETHYLENE
R. S. Hubner 1 Mar. 1964 47 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9418) OTS: $1.00

The results of the analyses of the ORNL Tower Shield experiments on neutron scattering from small volumes are presented and compared to the experimental data. Satisfactory agreement in the scattered dose is noted with both experiments and ORNL analytic methods. The calculated scattered spectra and n^{th} collision doses are presented. The Monte Carlo techniques used in the analysis are described in the appendix. Author

N64-17292 California U., Berkeley. Lawrence Radiation Lab.
PROGRAMS FOR CALCULATING RELATIVE INTENSITIES IN THE VIBRATIONAL STRUCTURE OF ELECTRONIC BAND SYSTEMS
Richard N. Zare 19 Nov. 1963 62 p refs
(Contract W-7405-ENG-26)
(UCRL-10925) OTS: $1.50

Source-deck listings of two computer programs are given for the calculation of relative intensities in the vibrational structure of an electronic transition. The first program finds turning points of an electronic potential-energy curve by direct numerical evaluation of the Klein action integrals in the RKR procedure. The second program uses these turning points to construct an effective potential for the molecule with rotational quantum number J. The radial Schrödinger equation then is solved for this potential to yield vibrational-rotational wavefunctions from which the program calculates Franck–Condon factors, r-centroids, and relative intensities. Author

N64-17293 California U., Berkeley. Lawrence Radiation Lab.
POLARIZATION OF SILVER NUCLEI IN FERROMAGNETS AND THE INTERNAL MAGNETIC FIELD
Gene A. Westenbarger 21 Nov. 1963 104 p refs
(Contract W-7405-ENG-48)
(UCRL-11143) OTS: $2.25

The silver nuclei were polarized by application of a small magnetic field to alloys that had been cooled to near 0.01° K. Thermometry was performed by measurement of the polarization of Co^{60} in the alloy. Spatial anisotropies of both beta and gamma rays from Ag^{104} and Ag^{110m} were measured. Parity was not conserved in the allowed beta decay of these isotopes. Spin assignments were made or confirmed for several excited states in Cd^{110}. The M1–E2 mixing ratios were determined for the 1,384-kev and 1,504-kev γ rays following the decay of polarized Ag^{110m}. The products of the nuclear magnetic moment of Ag^{110m} and the internal magnetic fields at the nuclei of silver dissolved in iron and nickel were found to be negative and equal to $-(9.0 \pm 0.5) \times 10^5$ nm gauss for Ag^{110m} in iron and $-(3.5 \pm 0.3) \times 10^5$ nm gauss in nickel. The role of conduction-electron polarization in the production of internal magnetic fields in ferromagnetic metals is discussed. Author

N64-17295* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
A MONTE CARLO CALCULATION OF THE NUCLEAR COLLISION DENSITY OF PRIMARY GALACTIC PROTONS IN A SLAB OF ALUMINUM
Millard L. Wohl Washington, NASA, Mar. 1964 18 p refs
(NASA TN D-2122) OTS: $0.50

A Monte Carlo code was written for the IBM 7090 computer. The code considers protons in the primary galactic energy range (0.1 to 10 Bev) impinging at angles of 0°, 30°, 45°, and 60°, as well as isotropically, on an infinite slab of aluminum 55 cm thick. The average proton nuclear collision density in each of six laminar regions of the slab is computed. In addition, the energy distribution of evaporation neutrons from the resulting excited nuclei is computed, and the statistical model is assumed to be valid. The proton collision density may be used as the spatial source density distribution for calculations of the transport of the secondary neutrons. Author

N64-17296* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROPOSED MECHANISM FOR THERMOPHOTOTROPIC BEHAVIOR IN PEROVSKITE-STRUCTURED TITANATES

Stanley M. Neuder Washington, NASA, Mar. 1964 17 p refs
(NASA TN D-2258) OTS: $0.50

Many compounds in the solid or liquid state have been known to change color when exposed to electromagnetic radiation. Thermophototropism is the term used to describe the phenomenon of radiation-induced coloration and thermally stimulated reversion to the original state. As a result of experimental investigations, a mechanism is proposed to account for thermophototropic behavior in perovskite-structured alkaline-earth titanates. A brief review of these experimental results and of several theories reported in the literature is included. Author

N64-17308 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
RESONANCES IN THE SMITH-PURCELL EFFECT
A. Hessel 2 Dec. 1963 29 p refs
(Contract AF 19(604)-7499)
(PIBMRI-1198-63; AFCRL-63-580; AD-430836)

A rigorous solution is derived for the problem of radiation of the Smith–Purcell type extracted from a radiofrequency-bunched electric current sheath above a plane exhibiting a periodically varying surface reactance. The plane is regarded as a model of an optical-reflection grating. The solution indicates that the presence of the grating will give rise to electromagnetic resonance effects that are closely related to the so-called Wood Anomalies encountered in optical-grating spectroscopy. Utilization of these resonances may be advantageous in generation of millimeter waves. Author

N64-17316 Queens Coll., Flushing, N.Y.
Technical Report No. 2 [INADMISSIBILITY OF LORENTZ-COVARIANT GRAVITATIONAL LAW THROUGH INCONSISTENCY WITH THE PRINCIPLE OF EQUIVALENCE]
A. L. Harvey Jan. 1964 8 p refs
(Grant Nonr(G)-00045-63)
(AD-431008)

Based on the strong form of the principle of equivalence, the flatness of Minkowski space–time, and the transformation properties of tensors, it is demonstrated that a Lorentz-covariant gravitational law in the form $f^{\alpha} = dp^{\alpha}/dt$ is not valid. Author

N64-17322 Oxford U. (Gt. Brit.) Clarendon Lab.
NUCLEAR MOMENTS OF THE LANTHANONS Technical Note No. 2
B. Bleaney (Pittsburgh U.) Sep. 1963 33 p refs Submitted for publication
(Contract AF 61(052)-677)
(AFCRL-63-531; AD-430576)

A simple formula is obtained for deriving the magnetic hyperfine constants A of the tripositive ions, Ln^{3+}, in the absence of crystal fields. These are corrected for the core polarization effect (estimated from results on ions with a half-filled 4f shell) to find the contribution A_f from f-electrons alone. This is compared with the values given by atomic beam measurements on the neutral atom, and it is shown that the ratio of $< r^{-3} >$ for ion to atom agrees within the experimental error with the ratio calculated by Judd and Lindgren in all cases except promethium. From the known nuclear moments of Nd, Er, Tm, and Yb, effective values of $< r^{-3} >$ are found; by interpolation, values for other ions are found with an error probability of less than 2%. These are used to estimate the nuclear moments in the other lanthanons. Author

N64-17325 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio School of Engineering
LIBRATION POINT STUDIES – AN ANALYTICAL APPROACH
Paul Michael Ulshafer (M.S. Thesis) Jun. 1963 48 p refs
(AD-432469) OTS: $4.60

Significant reductions in the amplitude of oscillations of a small body about the restricted three-body libration points can be attained through proper selection of initial conditions and the sun's position at the time of satellite insertion. These conditions can be closely approximated by minimizing the first-order solution of the restricted four-body equations of motion. The procedure used in this report succeeded in reducing peak amplitudes for stable motion, and divergence rates for unstable motion, by approximately 70 and 75 percent, respectively. Author

N64-17326 Göttingen U. (W. Germany) Physikalisches Inst.
RESEARCH ON SOUND PROPAGATION IN SOUND-ABSORBENT DUCTS WITH SUPERIMPOSED AIR STREAMS, VOLUME IV
F. Mechel, P. Mertens, and W. Schilz Wright-Patterson AFB, Ohio, Biophysics Lab., Dec. 1963 63 p refs
(Contract AF 61(052)-112)
(AMRL-TDR-62-140 (4); AD-431012) OTS: $1.75

Three projects are discussed: (1) The effects of various sound fields on the excitation of the boundary layer of a flat plate are discussed relative to the stagnation point and the boundary layer itself. Boundary-layer distortions are shown to be a function of the sound signal and flow velocity. (2) The change in the cross-sectional distribution of the sound pressure in an absorbent duct with airflow is examined with respect to the shape of the velocity profile of the flow. Even for wavelengths greater than the boundary-layer thickness, the sound pressure increased at the absorbing walls. (3) The dependence of the acoustic radiation impedance of a tube orifice during flow conditions is investigated as a function of the flow velocity and turbulence level. Results show that as the flow increases the radiation impedance decreases. Author

N64-17330 Pennsylvania U., Philadelphia
NON-THERMAL EFFECTS OF ALTERNATING ELECTRICAL FIELDS ON BIOLOGICAL STRUCTURES Annual Progress Report, 1962
Herman P. Schwan 31 May 1963 5 p refs
(Contract Nonr-551(05))
(AD-406795) OTS: $1.10

In the theory of pearl-chain formation, an approximate solution has not yet been developed for the most general case—particles and suspending fluid characterized by arbitrary dielectric constants and conductivities (assuming a dipole–dipole interaction). Although there is no exact theoretical solution available with which to assess the validity of the approximation, it may be expected to have an error that is not greater than that of the comparable approximation developed previously—perfect dielectric particles suspended in a perfect dielectric fluid. A theory has also been developed to describe the field strength necessary to cause orientation of a single spheroidal particle with the direction of the applied field. Theoretically, it is expected that for a given suspension of uniform spheroidal particles, the ratio of the threshold for pearl-chain formation to that for orientation should be almost completely determined by the eccentricity of the particle. Experimental verification of this prediction has been obtained. Orientation occurs first, then pearl-chain formation, as the field strength is increased. Author

N64-17358 Aerospace Corp., El Segundo, Calif.
PHOTO-INDUCED PHASE CHANGES IN LOW-TEMPERATURE GLASSES

Seymour Siegel and Henry S. Judeikis 12 Feb. 1964 24 p refs
(Contract AF 04(695)-269)
(TDR-269(4240-30)-4; SSD-TDR-63-376; AD-432781)

The UV irradiation ($\lambda > 2600$A) of ether and ethanol at 77° K leads to the formation of trapped ethyl radicals via an excited impurity-solvent interaction. The radicals were observed by the use of electron paramagnetic resonance (EPR) spectroscopy both during the irradiation and during the postirradiation period. The spectral shape changed as a function of time upon light extinction and also of temperature during irradiation. The qualitative kinetics of the spectral changes were examined in some detail. A model is proposed to explain the experimental observations. Author

N64-17385 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
COMPLEX GUIDED WAVES: PART II—RELATION TO RADIATION PATTERNS
T. Tamir and A. A. Oliner 30 Apr. 1962 43 p refs
(Contract AF 19(604)-7499)
(AFCRL-62-523; PIBMRI-1009-62; AD-286092)

The presence of complex waves in the near field of a source-excited plane homogeneous interface is shown to play an important role in determining certain features of the radiation field. A Kirchhoff–Huygens integration over the near field reveals that whenever these complex waves are strongly excited, they account for peaks in the radiation pattern. In the case of unidirectional excitation, each complex wave yields a single peak at some oblique angle; for bidirectional excitation, either two peaks appear symmetrically located with respect to a normal to the interface, or a single peak is present in this normal (broadside) direction. It is also shown that when the complex wave is slowly decaying at the interface, the peaks occur close to the angle of definition θ_c for that wave. These angles of maximum radiation and the associated gain functions are expressed, for all of these cases, in terms of the location in the steepest-descent plane of the pole corresponding to the complex wave. Author

N64-17387 Aerospace Corp., El Segundo, Calif. Systems Research Planning Div.
WIDEBAND MAGNETIC TAPE RECORDING TECHNIQUES
John Stumberg 15 Dec. 1963 64 p refs
(Contract AF 04(695)-269)
(TOR-269(9990)-1; AD-432458) OTS: $6.60

The problems, techniques, and state-of-the-art capabilities associated with wideband magnetic tape recorders are reviewed. Wideband is taken to mean the capacity to handle information signals with bandwidths exceeding approximately 4 mc. This restricts the type of magnetic recorder to the rotary head or video type recorder. The magnetic recording process and its fundamental limitations are discussed. An effort has been made to present as much information on time-base stability as possible in order to clarify the time stability characteristics of equipment now in the laboratory and in the field. One striking result of the study of wideband magnetic recording devices was the relative importance of a thorough and rigorous specification of the characteristics of ths signal to be recorded and reproduced. Realistic requirements on allowable signal degradation in the record-reproduce process should be firmly established before specifications are placed on the recorder. I.v.L.

N64-17483 Indiana General Corp., Valparaiso, Ind.
TEMPERATURE EFFECTS ON THE REMANENCE OF PERMANENT MAGNETS
R. K. Tenzer Wright-Patterson AFB, Ohio, Aeronautical Systems Div., May 1963 17 p refs
(Contract AF 33(657)-8499)
(ASD-TDR-63-500; AD-420235)

Effects of temperature on the remanence of commercially produced permanent magnets have been measured. Alnico II, III, IV, VI, VIII, Indox I and V, and Cunife magnets have been investigated with regard to reversible, irreversible, and material effects between −65° and +550°C. Results are shown in diagrams and tables. Alnico V, VI, and VIII magnets have performed best in this range. Author

N64-17464 Don Bosco Inst. for Research, Ramsey, N.J.
THE VIBRATION OF A SANDWICH PLATE WITH INTERNAL DAMPING, RADIATING INTO A FLUID MEDIUM ON ONE SIDE
Irving W. Jones and V. L. Salerno Jan. 1964 48 p
(Contract Nonr-4199(00))
(DBIR-103; AD-431932)

A theory is developed for the vibration analysis of an infinitely long sandwich plate whose facings and core both have linear damping properties. The plate is simply supported along its two edges. Solutions are obtained for the plate vibrating in vacuo and also for the plate radiating waves into a fluid medium that exists on one side. Expressions are derived for the natural frequencies and the steady-state response for both cases. Author

N64-17475 IIT Research Inst., Chicago, Ill. Technology Center
OPTICAL SPECTRA OF SOME LOW-MOLECULAR-WEIGHT COMPOUNDS USING THE MATRIX-ISOLATION TECHNIQUE Quarterly Technical Summary Report, 14 Nov. 1963-14 Feb. 1964
Alan Snelson [1964] 10 p refs
(Contract DA-31-124-ARO(D)-111; ARPA Order 458)
(IITRI-C6013-3; AD-432758)

Research is reported on the following: (1) aluminum fluoride; (2) aluminum monofluoride; (3) aluminum difluoride; and (4) beryllium fluoride. Appropriate free-energy functions and entropies for gaseous beryllium fluoride were calculated and are included. R.T.K.

N64-17481 Army Medical Research Lab., Fort Knox, Ky.
A PAIR OF NONPARAMETRIC INDICES OF AGREEMENT AND DISAGREEMENT
James N. Cronholm 9 Nov. 1963 42 p refs
(AMRL-592; AD-431642)

A new nonparametric index of agreement A, and its complement, $D = 1 - A$, an index of disagreement, based on multiple agreements and disagreements, are described. These statistics are compared with a pair of complementary indices, α and $\delta = 1 - \alpha$, based on pairwise agreements and disagreements. Expressions for A and D are presented, and their sampling distributions, expected values, biases, sampling variances, and limiting forms are derived. Tables of sampling probabilities, significantly extreme values, expected values, and standard errors are presented for A, D, α, and δ. An example is given, and the statistics are interpreted. A and D are compared with the pairwise indices with respect to several sampling properties. Author

N64-17482 Cincinnati U., Ohio
NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY LONG RANGE P^{31}-H^1 SPIN-SPIN COUPLING Technical Report No. 6

Fred Kaplan, Gurdial Singh, and Hans Zimmer 21 Nov. 1963 5 p refs
(Contract DA-ARO/D/31-124-G122; Contract DA-33-008-ORD-1971)
(AROD-2276-6; AD-432994)

The existence of long range P^{31}-H^1 coupling through four bonds has been determined from the examination of the nuclear magnetic-resonance spectra of several phosphorus-containing compounds. The compounds that exhibit the coupling contain the P-N-C-C-H system. Within this system, protonation and methylation result in a decrease in coupling, perhaps because of alteration of electron density and/or variation of bond angles, and quaternization leads to a similar decrease in coupling through three bonds. In contrast, long-range coupling is not observed in compounds containing the P-N-N-C-H system in which the presence of an intermediate nitrogen atom results in a large F-F coupling through four bonds. The Fermi contact interaction is considered to be the main contribution to long-range P^{31}-H^1 coupling through the agency of bonding electrons, although the possibility of coupling through space is not excluded. M.P.G.

N64-17486 California U., Los Angeles
THEORY OF THE NUCLEAR SHELL MODEL Final Report, 18 Sep. 1960–17 Sep. 1963
S. A. Moszkowski [1963] 11 p refs
(Contract DA-ORD-31-124-61-G382)
(AROD-1784-31; AD-432236) OTS: $1.60

Work carried out on the following problems in theoretical nuclear physics is summarized: (1) theory of nuclear matter—simulation of the hard core in the nucleon–nucleon potential by a velocity-dependent but nonsingular interaction; (2) nuclear surface—investigation of the accuracy of the Thomas–Fermi approximation (that the energy density of each point in a medium is a simple function of the local particle density and independent of its gradient); (3) nucleon–nucleon interaction—nucleon–nucleon scattering in terms of multipion resonances; (4) improved perturbation theory for quantum mechanics—improved method for calculating wavefunctions and eigenvalues in quantum mechanics; (5) nuclear coupling schemes—consideration of the configurations $(j)^2$ and $(j)^4$ with j ranging from jp to 13/2 and with maximum isotopic spin, interaction via a long range force; (6) two-dimensional analog of the nucleus; and (7) pairing effect in nuclei—relation of the nuclear pairing energies to the basic nucleon–nucleon interaction. P.V.E.

N64-17497 Hanford Atomic Products Operation, Richland, Wash.
INTENSITY OF BETA RADIATION AT THE SURFACE OF A FUEL ELEMENT
D. R. Dickinson Jan. 1964 21 p refs
(Contract AT(45-1)-1350)
(HW-79814) OTS: $0.50

The problem of calculating the beta intensity at a fuel element surface is discussed and is solved by summation of the contributions from each beta energy level from fission products. The net flux of beta particles through the fuel element surface and their rate of absorption at the surface, in terms of both number of particles and energy, are presented in graphs as functions of the cladding thickness for a given specific power level within the fuel. Author

N64-17500 Los Alamos Scientific Lab., N. Mex.
DOSE RATES, ACTIVITY, AND SHIELDING TRANSMISSION FACTORS FOR U^{235} FISSION PRODUCTS AFTER SHORT IRRADIATION
Donald A. Mc Kown 6 Mar. 1964 26 p
(Contract W-7405-ENG-36)
(LAMS-2963) OTS: $0.50

The calculated gamma dose rates and shielding dose transmission factors, with buildup for U^{235} fission products, are tabulated for various times after fission. The transmission factors are listed for lead, iron, concrete, aluminum, and water. The calculations are based on the U^{235} fission product gamma-ray spectra. Point-source geometry is assumed, and the buildup factors are for infinite media. Author

N64-17529 Atomic Energy Commission, Washington, D.C. Div. of Technical Information
LINEAR ION ACCELERATORS
D. V. Karetnikov, I. N. Slivkov, V. A. Teplyakov, A. P. Fedotov, and B. K. Shembel' Mar. 1964 235 p refs Transl. into ENGLISH by JPRS of the book "Lineniye Vskoriteli Ionov" Moscow, Gosatomizdat, 1962
(AEC-TR-6229) OTS: $3.00

The following are discussed: (1) operating principles of linear accelerators; (2) the theory of particle motion in an accelerator; (3) linear accelerator focusing; (4) high-frequency accelerating systems; (5) injector devices; (6) dielectric strength of the vacuum insulation and parasitic loads in accelerators; (7) problems of high-frequency power supply; and (8) the construction of linear accelerators. R.T.K.

N64-17558* Illinois U., Urbana
ULTRAHIGH VACUUM: A SURVEY
Daniel Alpert Repr. from Phys. Today, v. 16, no. 8, Aug. 1963 p 22–31 refs Based on a paper presented at the ann. meeting of the Am. Phys. Soc., New York, 25 Jan. [1963]
(NASA Grant NsG-376)

The recent history of ultra-high-vacuum technology is summarized. Methods for producing low pressures have caught up with the means of measuring them. Since the study of physical and chemical phenomena can only be carried out by using the best ultra-high-vacuum techniques, there is a merging of the scientific and technological motivations. These include: (1) the kinetics of gas-surface interactions at the interface; (2) the interaction of atomic particles, electrons, and photons with surfaces; and (3) the nature of the electronic bonds between adsorbed molecules and surfaces. R.T.K.

N64-17573* Chicago U., Ill. Labs. for Applied Sciences
ABSOLUTE FLUORESCENT QUANTUM EFFICIENCY OF SODIUM SALICYLATE
Rinda Allison, Jay Burns, and A. J. Tuzzolino [1962] 15 p refs Submitted for publication
(NASA Grant NsG-276-62)
(NASA CR-53230) OTS: $1.60 ph, $0.80 mf

The absolute fluorescent quantum efficiency of sodium salicylate was measured by two different methods and found to be 0.99 ±0.03 fluorescent quanta emitted per incident ultraviolet quantum at 2537 A. Measurements were also made at 1216 A and 1611 A by one of the methods, and the quantum efficiency was found to be 0.94 at both wavelengths. The energy conversion efficiency was found to be 0.57 at 2537 A, 0.35 at 1611 A, and 0.26 at 1216 A. The angular distribution of fluorescence radiation and the quantum efficiency were found to depend upon salicylate thickness. The quantum efficiency displays a broad maximum for thicknesses in the range 2 to 4 mg/cm^2, and the angular distribution follows closely a cosine law in this thickness range. Author

N64-17577* Stanford Research Inst., Menlo Park, Calif.
THREE-PARTICLE SCATTERING. II. IN SPACE
R. C. Whitten [1963] 25 p refs
(NASA Contract NASr-49(07))
(NASA CR-53233) OTS: $2.60 ph, $0.95 mf

The theory of three-particle collisions in a plane that was developed in an earlier paper is extended to scattering in space. Formal expressions for scattering amplitudes and cross sections are obtained for inelastic and rearrangement collisions as well as for elastic scattering. The optical theorem is also extended to the three-body case. The paper concludes with a discussion of the dynamics of a collision among three structureless particles that interact via a short-range potential. Author

N64-17580* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
LANDAU DAMPING AND RESONANT ENERGY ABSORPTION
Ching-Sheng Wu Repr. from Phys. Rev., v. 127, no. 5, 1 Sep. 1962 p 1419–1422
(NASA Contract NAS7-100; Contract NASw-6)
(NASA CR-53177; JPL-TR-32-270)

A physical interpretation of the Landau damping is given based on the Vlasov equations. It is shown that Landau's discussion and Kidal's calculation of resonant energy absorption are equivalent. It is also possible to compare the analysis based on the Vlasov equations to Dawson's intuitive formulation. Author

N64-17585* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
MOLECULAR ORBITAL STUDY OF THE $B\,^1\Sigma_u^+$ AND $^3\Sigma_u^+$ STATES OF THE HYDROGEN MOLECULE
Howard S. Taylor Repr. from J. Chem. Phys., v. 39, no. 12, 15 Dec. 1963 p 3375–3381
(NASA Contract NAS7-100)
(NASA CR-53202; JPL-TR-32-499)

The molecular orbital method is applied to the calculation of the potential curve of the $B\,^1\Sigma_u^+$ and of the $^3\Sigma_u^+$ states of the hydrogen molecule. Results comparable to those obtained using much more complicated wave functions are obtained. Author

N64-17587* Rensselaer Polytechnic Inst., Troy, N.Y. Interdisciplinary Materials Research Center
SEMICONDUCTING OXIDE GLASSES
J. D. Mackenzie [1964] 52 p refs
(NASA Grant NsG-100-60)
(NASA CR-53199) OTS: $5.60 ph, $1.76 mf

A general principle for the preparation of oxide glasses that are electronic conductors (semiconducting) is described. Various methods for proving electronic conduction in some of the glasses are discussed. The electrical conductivity and thermoelectric power of known semiconducting glasses, particularly glasses in the V_2O_5-P_2O_5-RO systems, are reviewed. Also included is a summary of possible applications of this type of semiconductor. P.V.E.

N64-17590* Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
SPECTRAL EMISSIVITY OF METALS AFTER DAMAGE BY PARTICLE IMPACT Final Report
Charles H. Leigh 13 Aug. 1962 68 p
(NASA Contract NAS8-1642)
(NASA CR-53235; RAD-TR-62-33) OTS: $6.60 ph, $2.24 mf

A determination was made of the reflectivity–emissivity changes produced by simulated micrometeorite impact on polished metals. The study was made on gold, aluminum, stainless steel types 304 and 316, chromium plate on brass substrate, tungsten, and silver. Micrometeorites were simulated by spherical zircalloy particles of 100 μ in diameter, accelerated to a velocity in excess of 5,000 fps. The light-gas gun system appeared most suitable for attaining high particle velocity with the required number of impacts over the sample area. The crater depth, diameter, and number of craters were measured for each metal. From the shape of the craters produced, it was concluded that the impact occurs in the low-to-transition region of the hypervelocity impact curve. The largest effect per particle impact was observable on the highly reflecting surfaces, such as silver and gold. Author

N64-17643 Utah U., Salt Lake City Microwave Devices Lab.
MICROWAVE DEVICES LABORATORY – CONSOLIDATED QUARTERLY REPORT, FOR THE PERIOD JULY 1, 1963 TO SEPTEMBER 30, 1963
1963 51 p refs
(Contract Nonr-1288(05); Contract AF 04(647)-745; Contract AF 33(657)-8677; NSF Grant-15017 and NSF Grant p-843)
(MDL-Q6; AD-431964)

The purpose of the research activity reported was to extend the useful frequency spectrum into the range from microwave frequencies to optical frequencies, and to improve existing devices and techniques in the microwave spectrum. Studies of electron-beam devices, solid-state devices, and plasmas are described. R.T.K.

N64-17671* Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS III: PHOTOIONIZATION CROSS SECTIONS OF THE RARE GASES
J. A. R. Samson and F. L. Kelly Jan. 1964 74 p refs
(NASA Contract NASw-840)
(NASA CR-55940; GCA-TR-64-3-N) OTS: $7.60 ph, $2.42 mf

The absorption cross sections of helium, neon, argon, krypton, and xenon have been measured from the photoionization threshold down to 280 A. The accuracy in the absolute value of the cross sections is estimated at $\pm 5\%$ and from 2% to 3% in the relative values. These results are compared to existing theoreties. Discrete structure due to excitation of inner shell electrons is discussed, and the electron energy levels are predicted where they have not as yet been observed. A table of critical absorption energies has been compiled. Finally, a discussion of the oscillator strengths for transitions to the photoionization continuum is given for each of the rare gases. C.L.W.

N64-17684* Lockheed Nuclear Products, Marietta, Ga.
EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES Quarterly Progress Report No. 12, Oct.-Dec. 1963
C. A. Schwanbeck [1963] 36 p
(NASA Contract NASw-114)
(NASA CR-56004; ER-6793) OTS: $3.60 ph, $1.28 mf

Investigation of the failure of nuclear instrumentation in the test loops continued. Temperature correlation measurements were obtained from an instrumented titantium test specimen. Erratic behavior of the refrigeration system expansion engines is being evaluated. The Mallory 1000 shield stud and plug were successfully modified by remote-handling techniques. Modification to the test loop carriages continued. A new chevron seal, made of polyurethane, was conceived, designed, and fabricated for the beam port. Flux measurements were made in HB-2 reactor beam port at

varying reactor operating conditions and different rod positions to better evaluate the time required to achieve an integrated dose of 1×10^{17} nvt fast neutrons (> 0.5 Mev) for in-pile tests. Author

N64-17685* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DISTRIBUTION OF UNBOUND CHARGED PARTICLES IN THE STATIC MAGNETIC FIELD OF A DIPOLE
Arthur D. Prescott 14 Jan. 1964 78 p refs
(NASA TM X-51312; MTP-RP-64-1) OTS: $7.60 ph, $2.54 mf

The distribution of relativistic unbound charged particles in the static magnetic field of a dipole with respect to a monoenergetic, isotropic, time-independent homogeneous distribution at infinity is determined by assuming Liouville's theorem and the Störmer theory of allowed and forbidden regions for unbound particle motion. The theory is applied to the dipole field of a finite current loop, and a study of the totally and partially shielded regions shows that the partially shielded region provides protection in the high-energy regime in which the totally shielded region is effectively nonexistent. Author

N64-17689* Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS I: THE PHOTOIONIZATION OF ATOMIC OXYGEN
A. Dalgarno, R. J. W. Henry, and A. L. Stewart Jan. 1964 33 p refs
(NASA Contract NASw-840)
(NASA CR-55949; GCA-TR-64-1-N) OTS: $3.60 ph, $1.19 mf

The formulation of a Hartree–Fock approximation for the final states of a transition involving the ejection of an outer or an inner shell electron from all ground state configurations $1s^2\ 2s^2\ 2p^q$ is presented, and the cross sections for the photoionization of atomic oxygen by radiation at wavelengths longer than 24 A are calculated. Author

N64-17694* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RELATIVISTIC ROTATION AND THE INVARIANCE OF MAXWELL'S EQUATIONS
William C. Orthwein Dec. 1963 34 p refs
(NASA TM X-54018) OTS: $3.60 ph, $1.22 mf

It is shown that Maxwell's vector equations are rotationally invariant in the usual sense; that is, they assume the same vector form in each of two orthogonal coordinate systems that experience a relative angular velocity. This conclusion depends upon the well-known invariance of the Minkowski tensor formulation of Maxwell's equations and upon the heretofore uncertain orthogonality and flatness of space–time as seen by a rotating observer. Because there has been some question in the past regarding the curvature of the rotating space, this matter is first resolved by pointing out an apparently unnoticed but, nevertheless, fundamental distinction between transformations in space only, and those in space–time. Once the properties of space–time transformations are established, it then follows that the rotating space is Euclidean even though time and circumferential distance undergo Lorentz contractions. Author

N64-17701 Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Lab.
ULTRASONIC WAVE PROPAGATION MODELS FOR NONDESTRUCTIVE TESTING: LIQUID-LIQUID INTERFACES
C. E. Fitch Oct. 1963 49 p refs
(Contract AT(45-1)-1350)
(HW-78701) OTS: $1.25

Basic analytical and experimental studies to determine the accuracy of simple, plane-wave, ultrasonic propagation models in liquids were undertaken. Liquid-liquid interfaces were chosen for initial studies on the effects of attenuation and boundary waves. The studies on attenuation were confined only to its influence on propagating wave structures and did not include any considerations about the mechanisms of energy removal. Boundary-wave studies were not completed; however, results were obtained that indicate the influence of boundary waves on wave propagation. Plane waves, infinite in both time and space, incident on a liquid-liquid interface were studied analytically for the cases in which neither liquid was attenuating, in which only the refracting liquid was attenuating, and in which both liquids were attenuating. Glycerine and kerosene were chosen for the experimental studies on liquid-liquid interfaces. Measurements for the respective acoustic properties of these liquids were made, and subsequent experimental data obtained with specially designed equipment were in close agreement with the analytical results for liquid-liquid interfaces. R.T.K.

N64-17704 Hanford Atomic Products Operation, Richland, Wash.
ACCURATE EIGENVALUE MATRIX TREATMENT OF GENERAL FISSILE INTERACTION
F. R. Czerniejewski 25 Mar. 1964 34 p refs
(Contract AT(45-1)-1350)
(HW-80213) OTS: $1.00

Derivations and approximations are presented that describe the nuclear interaction between subcritical, cylindrical units of fissile material. Matrix theory is used throughout, and the interaction probability is formulated as a surface integral of the solid angle between units to yield an accuracy of ±5% on measured critical assemblies. Flexibility is extended to cover arbitrary arrangement, height, and nuclear characteristics for each unit, and the contribution of external reflectors is also accounted for. A FORTRAN code is described, which makes use of the theory. Author

N64-17716 Bureau of Mines, Minneapolis, Minn.
ACTIVITIES OF COPPER AND NICKEL IN LIQUID COPPER-NICKEL ALLOYS
C. W. Schultz, G. R. Zellars, S. L. Payne, and E. F. Foerster 1964 13 p refs
(BMRI-6410)

The vapor pressure of copper in a series of liquid copper–nickel alloys was determined by the carrier gas method. The activity and activity coefficient of copper were calculated over the entire range of alloy composition. These data show a slight positive deviation from ideal behavior. The activity coefficient of copper was highest (2.10) at 0.05 mole fraction copper and approached unity at concentrations above 0.85 mole fraction copper. The results for nickel were calculated from the copper data by the graphical integration of the Gibbs–Duhem equation. Author

N64-17739 Iowa State U. of Science and Tech., Ames Ames Lab.
OSMOTIC AND ACTIVITY COEFFICIENTS OF SOME AQUEOUS RARE-EARTH CHLORIDE SOLUTIONS AT 25° C
Harry Homer Petheram (M.S. Thesis) and F. H. Spedding May 1963 74 p refs
(Contract W-7405-ENG-82)
(IS-770) OTS: $1.75

The least square equations obtained for the osmotic coefficient as a function of molality for erbium and yttrium chloride solutions resulted in a mean deviation of 0.0019 and 0.0024

in the osmotic coefficient, respectively, for the two solutions. These deviations at a median osmotic coefficient are 0.08% for erbium chloride and 0.10% for yttrium chloride. All deviations in the activity coefficient gave an almost uniform mean deviation of 0.23%. The osmotic and activity coefficients for the rare-earth chlorides, determined by Spedding and Saeger and by this research, show a marked increase across the series, particularly at high concentrations. The osmotic and activity coefficients of yttrium chloride behave like those of the heavy rare-earth chlorides. The high-activity coefficient of concentrated rare-earth chloride solutions strongly indicates that complete ionization of the electrolyte is far from being the case. Author

N64-17743 Oak Ridge National Lab., Tenn. Reactor Div.
EFFECTS OF TEMPERATURE ON FISSION-PRODUCT DEPOSITION
M. N. Ozisik Mar. 1964 28 p refs
(Contract W-7405-ENG-26)
(ORNL-3542) OTS: $0.75

An analytical model developed for steady-state deposition on fission products from gas streams onto conduit surfaces is extended to include the effects of axial and radial temperature variations. A computer code that evaluates the equations is described, and sample results are presented that compare the calculated values with experimental data. Author

N64-17753* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
FLIGHT EVALUATION OF WIDE-ANGLE OVERLAPPING MONOCULARS FOR PROVIDING PILOT'S FIELD OF VISION
Paul L. Chenoweth and William H. Dana Washington, NASA, Apr. 1964 17 p refs
(NASA TN D-2265) OTS: $0.50

A qualitative evaluation was made of the effectiveness of wide-angle, overlapping monoculars as the sole source of outside visual reference during takeoffs, aerial maneuvers, visual navigation, and approaches and landings in a light observation aircraft. The evaluation was made during the day and at night and in air conditions that varied from no turbulence to severe turbulence. The monoculars provided pilot visibility that was adequate for gross control of angle of pitch and angle of sideslip and precise control of bank angle. When used in conjunction with an altimeter and airspeed indicator, the optics gave the pilot enough information with which to satisfactorily perform takeoffs, visual navigation, mild aerial maneuvers, and power-off approaches through the landing flare. The system was as suitable for outside visual reference during night operation as during the day and was satisfactory for flight in light and moderate turbulence. Author

N64-17756 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
ON THE LOUDNESS OF UNMASKED AND MASKED SOUNDS [UBER DIE LAUTHEIT VON UNGEDROSSELTEN SCHALLEN]
E. Zwicker Jan. 1964 27 p refs Transl. into ENGLISH from Akust. Beih. (Germany), v. 13, no. 1, 1963 p 194–211 (TIL/T-5470)

The limits within which it is possible to mask loudness or sound intensities are determined from subjective measurements. The intensity of 1000 cps notes masked by narrow-band noise and steady exciting noise is determined by eight observers. These measurements are supplemented by additional measurements of masked sounds and also by measurements of the unmasked total intensity. From the results, a group of curves is obtained for the masked specific loudness of notes. With the help of these curves, the loudness or intensity of notes masked by noise can be calculated. It follows from the experimental results that notes and noise differ in regard to their masking effects but that this difference has no influence on the unmasked total loudness and thus on the calculation of the sound intensity. Comparisons further show that the sum of the masked component loudnesses of mutually masking sounds gives the total loudness. Author

N64-17758 Stanford Research Inst., Menlo Park, Calif. Poulter Research Labs.
SHOCK WAVE PROPAGATION ON A ONE-DIMENSIONAL LATTICE
G. D. Anderson (Ph.D. Thesis–Washington State U.) 20 Feb. 1964 78 p refs
(Poulter Res. Lab. TR-001-64)

A review of the one-dimensional flow of an ideal compressible fluid is presented that illustrates the formation of a shock from a simple adiabatic compressional wave. The Rankine–Hugoniot jump conditions that hold across a shock are derived, and it is shown that for weak shocks the entropy increase is third order in the volume change. It is also shown that, for stable compressive shocks, the curvature of the reversible adiabat in the pressure–volume plane must be positive. R.T.K.

N64-17759 California U., Berkeley Lawrence Radiation Lab.
PHYSICS DIVISION SEMIANNUAL REPORT, MAY-OCTOBER 1963
Luis W. Alvarez et al 22 Nov. 1963 114 p refs
(Contract W-7405-ENG-48)
(UCRL-11132) OTS: $2.25

The current program status includes the following areas: (1) the K-72, K-63, and π-63 experiments in the 72-inch bubble chamber; (2) search for Dirac monopoles in meteorites by the use of electromagnetic techniques; (3) data reduction of the 72-inch H_2 bubble-chamber film; (4) the development of error-correction feedback to the scanning and measuring projector operator, simplification of the measuring operations, and conversion of the present 709-programs for use on the 7040-computer; (5) heavy-ion research; (6) particle interaction; (7) theoretical physics; (8) mathematics and computing services; (9) the systematic measurement of various atomic and nuclear properties of radioactive isotopes; (10) scattering experiments with a polarized proton target; (11) antiproton annihilation in deuterium; (12) development of the 25-inch bubble chamber; (13) modifications to the 184-inch cyclotron; and (14) specifications for the 88-inch cyclotron. I.v.L.

N64-17775 European Atomic Energy Community, Brussels (Belgium)
HEAT TRANSFER IN A FUEL ELEMENT GAS GAP
S. Giuliani and C. Mustacchi Joint Nucl. Res. Center, Ispra Estab. (Italy), 1964 25 p ref
(EUR-521.e) Available from Belgian American Bank and Trust Co., N.Y., account no. 121.86: 40 Belg. Fr.

The effects of gas accommodation of noble gases on uranium monocarbide and aluminum surfaces are investigated. The results are used to estimate the temperature drop in the fuel-clad clearance of a fuel element. Author

N64-17779 Argonne National Lab., Ill.
FISSION PRODUCT MONITORING IN EBR-I, MARK IV
R. R. Smith and C. B. Doe Jan. 1964 14 p refs
(Contract W-31-109-ENG-38)
(ANL-6788) OTS: $0.50

A method of beta–gamma detection, which monitors the activity of the cover gas A^{41} and is capable of annunciating a cladding failure in the EBR-I, Mark IV, is described. This method utilizes the selective electrostatic fixation of rare-gas daughter nuclides. The principle of the fixation process is premised on the fact that at the instant of beta decay, each of the daughter species becomes a positively charged ion. Accordingly, the cover gas is passed through an electrostatic precipitation unit, which consists primarily of a cylinder maintained at a potential of 2,500 v positive. A closed-loop wire, driven axially through the cylinder, is maintained at ground. Upon beta decay, the ionized daughter species migrate to the wire and become electronically neutralized. The wire carrying the neutralized daughters passes through a mercury trap-type gas seal, which has a few millimeters of water floating on its surface. The strongly electropositive Rb and Cs daughters react instantly with the water, and become permanently fixed in the water layer in the hydroxide form. The isotope K^{41} the daughter of A^{41}, also reacts with water, but since K^{41} is radioactively inert, the activity associated with the water fraction is almost exclusively that arising from the decay of various Rb and Cs fission products. I.v.L.

N64-17785 Naval Radiological Defense Lab., San Francisco, Calif.
FRACTIONATION IV: ILLUSTRATIVE CALCULATIONS OF THE EFFECT OF RADIONUCLIDE FRACTIONATION ON EXPOSURE-DOSE RATE FROM LOCAL FALLOUT
E. C. Freiling, M. A. Kay, and J. V. Sanderson 6 Jan. 1964 32 p refs
(USNRDL-TR-715; AD-431227)

This report illustrates a proposed definition of surface density of contamination for the deposit of fractionated fallout. The illustrations employed give estimates of the dependence of exposure dose rate on the degree of radionuclide fractionation and of the sensitivity of this dependence to independent fission yield input data, total yield of the device, and time of exposure. Author

N64-17802 California U., Berkeley Inst. of Engineering Research
EXPERIMENTAL INVESTIGATION OF LITHIUM-ARGON SPUTTERING
V. Malakhof, R. P. Stein, and H. P. Smith, Jr. 25 Nov. 1963 53 p refs Submitted as M.S. Thesis
(Contract Nonr-222(45))
(AS-63-7; AD-431762) OTS: $5.60

The angular distribution of the sputtered lithium atoms under bombardment by positive argon ions was investigated. The results indicate that at low ion energies and oblique angles of incidence the angular distribution is predominantly in the forward hemisphere relative to incident beam direction, and depends on the angle of ion incidence. The maximum forward sputtering current occurs at approximately 90° to the beam direction. At low angles of incidence, i.e., below 30° back-sputtering is possible. There is approximately a 40° relationship between the maximum back-sputtering current and the angle of ion incidence. Author

N64-17822* General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
ESTIMATION OF THE COLLISION-INDUCED DISSOCIATION RATES OF DIATOMIC AND TRIATOMIC MOLECULES Final Report
C. Frederick Hansen Feb. 1964 40 p refs
(NASA Contract NAS7-217)
(NASA CR-53345; TR64-14) OTS: $3.60 ph, $1.40 mf

Collision-induced dissociation rates for diatomic and triatomic molecules are estimated from a version of the available energy theory. The collision is assumed to excite one mode of internal momentum in an unbounded Boltzmann-like distribution, and the number of energy modes used in the dissociation process is taken to be the total number of internal modes of the molecule before dissociation, less the number of internal modes in the molecular fractions produced. This model is found to agree with available experimental data, generally within a factor of 10, over a wide range of temperature and for a wide variety of collision partners. Author

N64-17835 Iowa State U. of Science and Tech., Ames Ames Lab.
THE FERMI SURFACE OF LEAD
James Robert Anderson and A. V. Gold 1 Jan. 1964 237 p refs
(Contract W-7405-ENG-82)
(IS-762) OTS: $3.00

An apparatus has been designed and constructed to extend magnetic fields to 200 kG. With the aid of these higher fields, many new features of the Fermi surface in lead have been determined quantitatively. The shape of the Fermi surface can be explained in terms of an orthogonalized-plane-wave model using only two parameters, the two Fourier components of the pseudopotential, V_{111} and V_{200}. Although the orthogonalized-plane-wave approach is successful in describing the shape of the Fermi surface, the calculated cyclotron masses are too small by a factor of order two. The theoretical implications of this are discussed briefly. De Haas–van Alphen oscillations have been observed in iron whiskers—the first time that the effect has been observed in a ferromagnetic metal. Preliminary results show that the saturation magnetization in iron must be taken into account in order to determine the true periods of the oscillations. Author

N64-17836 California U., Berkeley. Lawrence Radiation Lab.
A MEASUREMENT OF THE FORWARD DIFFERENTIAL CROSS SECTION FOR $\pi^- - p$ ELASTIC CHARGE-EXCHANGE SCATTERING AT 1.03 BeV/c USING THE 72-INCH HYDROGEN BUBBLE CHAMBER AS A NEUTRON DETECTOR
Alan Natapoff (Ph.D. Thesis) Dec. 1963 121 p refs
(Contract W-7405-ENG-82)
(UCRL-11150) OTS: $2.25

This paper describes a low statistics measurement of the forward differential cross section, $d\sigma^{CE}(0)/d\Omega$, at 1.03 Bev/c in the 72-inch hydrogen bubble chamber. The π^- beam comes from the Bevatron, and the secondary neutrons are detected when subsequent elastic scatters $n + p \rightarrow n + p$ yield visible stopping protons. The real events were separated from the spurious by a Boolean algebraic method that reduced the set of all events to a sum of a small number of physically significant sets. The residual background fraction was estimated at 10% by a computer simulation technique using the known beam distribution and a pure sample of background events. The bubble chamber, so used, detects about 5% of the secondary neutrons emitted in the charge-exchange reaction. Author

N64-17837 European Organization for Nuclear Research, Geneva (Switzerland)
A NEW "SPLIT-POLE" QUADRUPOLE LENS
A. Asner, P. Bossard, and F. Rohner 30 Jan. 1964 36 p refs
(CERN 64-5)

The theory, the design, and the performance of the first 1.5-m-long, 0.5-m-overall-width, 930 G/cm "split-pole" quadrupole lens are given. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see:* 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-16935 Princeton U., N.J. Plasma Physics Lab.
DENSITY FLUCTUATIONS IN THE ETUDE STELLARATOR
K. Bol Sep. 1963 46 p refs
(Contract AT(30-1)-1238)
(MATT-224)

Density fluctuations of the ohmically heated plasma of the Etude stellarator can be resolved into azimuthally propagating waves by means of narrow-band correlation measurements. At frequencies below roughly 100 kHz, propagation velocities are comparable to macroscopic plasma velocities, but increase with frequency and azimuthal mode number. Kink or field degeneracy modes, such as those found on B-1, dominate the spectrum of azimuthal modes at appropriate plasma currents. At frequencies above 100 kHz, the wave-propagation velocity tends to become constant at a value nearly an order of magnitude larger than either the ion diamagnetic drift or the mean column rotation velocity, but remains in the same direction. Author

N64-16936 Princeton U., N.J. Plasma Physics Lab.
RECENT DEVELOPMENTS IN CONTROLLED FUSION
A. S. Bishop Jan. 1964 30 p Presented at the Northeastern Conf. of the Am. Inst. of Elec. and Electron. Eng., Boston, Nov. 4, 1963
(Contract AT(30-1)-1238)
(MATT-241)

The topics discussed include: (1) the basic problems in the field of controlled fusion; (2) the major approaches toward the goal of controlled fusion, and recent developments in each of these approaches; and (3) the Stellarator program. R.T.K.

N64-16937 Princeton U., N.J. Plasma Physics Lab.
INCOHERENT ELECTROMAGNETIC SCATTERING FROM DRIVEN PLASMA OSCILLATIONS
Herbert L. Berk Nov. 1963 12 p refs
(Contract AT(30-1)-1238)
(MATT-230)

A proposal is offered to measure the scattered radiation from driven plasma oscillations of a fully ionized plasma. The plasma oscillations are generated by an external field whose frequency is slightly greater than the plasma frequency. A second radiation beam of higher frequency will scatter at the difference frequency. The scattering cross section will then be greatly enhanced in one preferred direction, which corresponds to scattering by the plasma oscillations. Author

N64-16944 Princeton U., N.J. Plasma Physics Lab.
KINETIC THEORY OF WEAKLY COUPLED GASES
C. H. Su, E. A. Frieman, and M. D. Kruskal Jan. 1964 152 p refs
(Contract AF(30-1)-1238)
(MATT-238)

Using the multiple-time-scale method on the B-B-G-K-Y hierarchy, the weak coupling expansion is carried out to higher orders. It is found that there are two local breakdowns of the expansion. One occurs at small relative velocities between particles. The correct asymptotic representation for the small relative velocity region is given. The second breakdown occurs for particles having a large separation at t with their relative velocity oriented in such a way that they were in collision at t = 0. Such a breakdown indicates that in contrast to the Bogoliubov functional assumption, the higher order correlation functions should vary on the kinetic time scale in their own right. A sufficient condition on the smoothness of the initial correlation functions is given such that the Fokker–Planck equation is obtained as the lowest order approximation in the expansion. The connection between irreversibility and the requirement of nonsecularity in the multiple-time-scale formulation is also indicated. Author

N64-17119 Avco-Everett Research Lab., Everett, Mass.
RADIANT ENERGY LOSS FROM A CESIUM-ARGON PLASMA TO AN INFINITE PLANE PARALLEL ENCLOSURE
Michael A. Lutz Sep. 1963 39 p refs
(Contract AF 04(694)-33)
(Avco-Everett-Res. Rept.-175; BSD-TDR-64-6; AD-431640)

An integral equation dependent on the spectral absorption coefficient is derived for the radiant energy flux to the wall of an infinite plane parallel enclosure. An approximate spectral absorption coefficient for any alkali metal vapor is found for both continuum and line radiation. Specific calculations are performed for a cesium–argon mixture with a cesium atom density of 10^{16}/cc, an argon pressure of 1 atmosphere, an argon temperature of 2,000° K, and electron temperatures of 2,000°, 2,500°, and 3,000° K. The flux to the wall is then computed numerically for planes separated by 1 cm, 10 cm and 100 cm. Continuum, line, and total radiation losses are given for each of the nine cases treated. The magnitude of the results indicates that radiant energy losses are not to be neglected in practical calculations based on a two-temperature model. Author

N64-17154* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE EQUILIBRIUM SONIC-FLOW METHOD FOR EVALUATING ELECTRIC-ARC AIR-HEATER PERFORMANCE
Warren Winovich Washington, NASA, Mar. 1964 36 p refs
(NASA TN D-2132) OTS: $1.00

The assumption that the airflow up to the sonic point in the discharge nozzle of an air heater can be represented by an isentropic expansion under equilibrium conditions is used to show that the flow rate and the heater reservoir pressure uniquely relate the total enthalpy level of the air. The relation is described by an empirical equation in closed form for pressures from 0.1 to 100 atmospheres and enthalpy levels up to 10,000 Btu/lb. A discussion of the method, the assumptions, and the applications to electric-arc air heaters is presented. Comparisons of the enthalpy measured by the present method and by heat-transfer measurement show good agreement. Author

N64-17162* National Aeronautics and Space Administration. Washington, D.C.
FUNDAMENTALS OF COSMIC ELECTRODYNAMICS

S. B. Pikel'ner Feb. 1964 273 p refs Transl. into ENGLISH of the book, "Osnovy kosmicheskoy elektrodinamiki", Moscow, State Publ. House for Physico-Mathematical Lit., 1961
(NASA TT F-175) OTS: $4.00

The present work is designed to present systematically the basic notions of cosmic electrodynamics and to show how these ideas relate to astrophysics and geophysics. The subject matter presented includes the following: (1) plasma with no magnetic field; (2) plasma in a magnetic field; (3) the interaction of a magnetic field and a moving conducting medium; (4) plasma waves; (5) stability; (6) increase in field strength resulting from motion of a medium; and (7) applications to astrophysics. Author

N64-17182 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EFFECT OF ELECTROSTATIC INSTABILITIES ON THE FUNCTION OF DISTRIBUTION OF THE BEAM, WHICH REACTS WITH PLASMA IN MAGNETIC FIELD
V. D. Shapiro and V. I. Shevchenko *In its* Ukr. J. of Phys. (Selected Articles) 4 Apr. 1963 p 9–12 refs (See N64-17179 09-23)

In this report, equations are derived that describe plasma oscillations that are longitudinal and axially symmetrical in the plane perpendicular to the magnetic field. R.T.K.

N64-17202 Princeton U., N.J. Plasma Physics Lab.
PLASMA WAVES (CMA DIAGRAM)
William M. Hooke *In* Md. U. Proc. of the Space Communications Inst., Md. U., College Park, Jun. 23–28, 1963 p 93–101 refs (See N64-17194 09-08) OTS: $9.10 ph, $3.50 mf

The CMA (Clemmow–Mullaly–Allis) diagram is used to classify and describe the various types of waves. The theoretical model on which the diagram is based is very simple—no collisions, low temperature, and no boundaries. There are, however, no limits on the wave frequency, ω, the unperturbed magnetic field, B_0, or the density, N_e. A plane monochromatic wave of wave number k is assumed to propagate at an arbitrary angle, Θ, with respect to B_0. The CMA diagram is a two-dimensional plot with Ω e^2/ω^2 and $^{\varkappa}e^2 + {}^{\varkappa}i^2/\omega^2$ being the ordinate and abscissa. The diagram is divided into 13 regions by 7 lines. Each of these lines represents a cutoff ($k^2 = 0$) or a resonance ($k^2 \rightarrow \varkappa$). These lines separate regions containing different mode types. In each of the 13 regions, polar plots of phase velocity may be drawn. Since the physical problem is cylindrically symmetrical about B_0, these curves are surfaces of revolution about the axis defined by $\Theta = 0$. Wave-normal plots may be drawn at one point in parameter space, and these surfaces will qualitatively represent the type of surface that exists throughout that entire region of parameter space. The upper right-hand corner of the diagram contains two surfaces, one "spheroid" and one "dumbell lemniscate." The left side of the diagram represents the general region in which the plasma is so tenuous that the displacement-current term is greater than the conduction-current term. I.v.L.

N64-17247 Aeronautical Research Council (Gt. Brit.)
A PRELIMINARY STUDY OF IONIC RECOMBINATION OF ARGON IN WIND-TUNNEL NOZZLES, PART II
K. N. C. Bray and J. A. Wilson London, HMSO, Jul. 1963 52 p ref
(ARC-CP-634; supersedes AASU-185; ARC-23290) HMSO: 9s

A study has been made of electron–ion recombination in the flow of a partially ionized Argon plasma through wind-tunnel nozzles. Effects of thermal conduction, convection, and two-body recombination processes are neglected, but the temperatures of the ions and electrons are allowed to differ. The equations have been integrated for a variety of stagnation conditions, and it has been shown that, for the cases considered, the flow is far removed from thermal equilibrium. Furthermore, as a result of this effect alone, large differences between the temperatures of the heavy particles and the electrons are predicted. The phenomenon of " sudden freezing", characteristic of atomic recombination, is not encountered, because of the exponential temperature dependence of the recombination rate, which results from the assumed ionic recombination mechanism. Author

N64-17253 Princeton U., N.J. Plasma Physics Lab.
PRELIMINARY RESULTS ON THE INTERPRETATION OF LOW-FREQUENCY FLUCTUATIONS OBSERVED IN THE REFLEX ARC
Francis F. Chen Jan. 1964 19 p refs
(Contract AT(30-1)-1238)
(MATT-249)

Data taken in 1961 to 1962, in collaboration with R. Bingham and A. W. Cooper, on the electrostatic fluctuations in reflex discharges are interpreted as follows. Instabilities are generated whenever the density gradient is inward. The nature of the oscillations is such that they tend to wipe out the density gradient. They succeed in doing so in the body of the discharge, where the gradient is zero and, in fact, is reversed because of loss by streaming along the axis, the potential barrier for electrons being very small in this area. At the edge of the discharge, there must be a layer where the gradient is negative and the fluctuations continue to be generated here. The reason that oscillations are detected in the stable region is that there must be a small component of k along r, and the oscillations propagate inward from the generation region. Also, in conjunction with the interpretation, the aims were: (1) to show how the frequently observed low-frequency fluctuations in a partially ionized gas in a magnetic field can arise; (2) to point out the importance of ion inertia in such instabilities; and (3) to show how to treat axial damping properly when $\lambda_{\parallel}$ is larger than L, where $\lambda_{\parallel}$ is the density distribution and L is the length of the machine. These aims were accomplished. I.v.L.

N64-17257 Weapons Research Establishment (Australia)
ON THE MECHANISM OF THE PENNING DISCHARGE
E. H. Hirsch Dec. 1963 24 p refs
(Tech. Note CPD-76)

Experiments confirm that the maintenance of a Penning discharge in its normal mode is governed by a relatively thin electron sheath situated in the vicinity of the anode. It is also shown that electron transport to the anode cannot be explained in terms of classical crossfield diffusion, but that another transport mechanism is present, which presumably operates in magnetrons and other magnetically confined discharges. The existence of excess energy electrons in Penning discharges is demonstrated, and mode changes are shown to be associated with the appearance of these electrons in certain regions of the discharge. Author

N64-17286 Stanford U., Calif. Microwave Lab.
TRANSVERSE FIELD INTERACTIONS OF A BEAM AND PLASMA
G. S. Kino and R. Gerchberg Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Jan. 1964 19 p refs
(Contract AF 33(616)-8121)
(ARL-64-16; AD-431859)

A new type of beam plasma interaction is described in which the basic RF motion is transverse to the d.c. velocity of

the beam. It is shown that instabilities should occur near the electron plasma frequency. In the presence of a magnetic field further instabilities occur near the ion plasma frequency. An experiment has been performed to check the theory using an ion focused beam without magnetic field. As much as 25-db gain was observed in a 10-cm length at 450 mc. Author

N64-17300 RAND Corp., Santa Monica, Calif.
INCOHERENT SCATTERING OF RADIO WAVES BY A PLASMA
D. F. Du Bois and V. Gilinsky Jan. 1963 24 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3440-PR; AD-296931)

The incoherent scattering of radio waves from a hot plasma is computed using the diagrammatic techniques of quantum electrodynamics. This method simplifies previously obtained results and permits extensions to include the effects of close collisions. Author

N64-17307 Polytechnic Inst. of Brooklyn, N.Y. Microwave Res. Inst.
PARALLEL PLATE SIMULATOR FOR A PLASMA SLAB Scientific Report No. 3
John D. Schlafer 6 May 1963 21 p refs
(Contract AF 19(604)-7216; Contract AF 33(657)-10820)
(PIBMRI-1162-63; AFCRL-63-593; AD-430845)

An investigation of an inert parallel plate structure is carried out in an attempt to determine its ability to represent, satisfactorily, a homogeneous, isotropic, lossless plasma slab. Among the parameters compared are the propagation constants and the plane wave reflection coefficients. An analogy is drawn between the H-mode excited plasma slab and the E-mode excited parallel plate structure. The plate structure is found to support a leaky surface wave mode. Author

N64-17346 Joint Publications Research Service, Washington, D.C.
EXPERIMENT ON THE AREA OF MOVEMENT OF CHARGED PARTICLE IN DIPOLE MAGNETIC FIELD
Chao Chiu-chang, Hsu Yung-lan, and Chou Kuo-ch'eng *In its* Transl. on Communist China's Sci. and Technol. No. 75 19 Mar. 1964 p 57-61 Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 11, 1963 p 56-57 (See N64-17342 09-01) OTS: $2.25

The area of movement of charged particles in the dipole magnetic field and the corresponding changes of these areas of movement, under the effect of interferences, were investigated. Results indicate that: (1) When the parameter of movement of a charged particle in the dipole magnetic field is −0.1, the capture area where the particle's movement takes place on the surface of the equator will have a width equal to the diameter of the particle's gyroscopic motion in the magnetic field. (2) When the dipole magnetic field suffers a magnetic-field disturbance, the magnetic lines of the dipole magnetic field will change, and, at the same time, the border of the particle movement area will also change. The directions of a uniform magnetic-field disturbance, or of a magnetic-field disturbance produced on the surface of the equator, by the current loop near the center of a dipole, are opposite to the direction of the dipole magnetic field. (3) When the magnetic field is sufficiently strong, the border of the movement area and the magnetic line are identical. Also, certain characteristics of the movement of charged particles in the electromagnetic field are discussed, based on the particle's area movement in the electromagnetic field. I.v.L.

N64-17352* Texas U., Austin Plasma Dynamics Research Lab.
PROPAGATION AND DISPERSION OF HYDROMAGNETIC AND ION CYCLOTRON WAVES IN PLASMAS IMMERSED IN MAGNETIC FIELDS Second Semiannual Status Report, Jul. 15, 1963-Jan. 14, 1964
Arwin A. Dougal 15 Jan. 1964 30 p refs
(NASA Grant NsG-353)
(NASA CR-53229) OTS: $2.60 ph, $1.10 mf

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2. CURRENT SHEATH DYNAMICS AND MAGNETOSONIC OSCILLATIONS IN MAGNETOPLASMAS O. M. Friedrich, Jr. p 8-14 refs (See N64-17354 09-24)

3. RESONANCES AND WAVES IN ONE- AND TWO-ION SPECIES PLASMAS SUBJECTED TO INTENSE MAGNETIC FIELDS M. Kristiansen p 15-21 refs (See N64-17355 09-24)

N64-17353 Texas U., Austin Plasma Dynamics Research Lab.
ANALYSIS OF WAVES IN BOUNDED MAGNETOACTIVE PLASMA
Y. J. Seto *In its* Propagation and Dispersion of Hydromagnetic and Ion Cyclotron Waves in Plasmas Immersed in Magnetic Fields 15 Jan. 1964 p 1-7 ref (See N64-17352 09-24) OTS: $2.60 ph, $1.10 mf

The problem investigated is the analysis of radially travelling waves in a plasma slab bounded by two infinitely large, conducting, parallel plates, with a static magnetic field imposed upon the plasma in a direction normal to the surface of the boundary plates. The waves are assumed to be excited by one of a number of current sources, each with an arbitrarily chosen configuration and current distribution. The transition of the finite domain Green's dyadic to that of the infinite domain is discussed. As the first case of radial wave analysis, results for the waves excited by a simple line source of constant current distribution are presented. R.T.K.

N64-17354 Texas U., Austin Plasma Dynamics Research Lab.
CURRENT SHEATH DYNAMICS AND MAGNETOSONIC OSCILLATIONS IN MAGNETOPLASMAS
Otto M. Friedrich, Jr. *In its* Propagation and Dispersion of Hydromagnetic and Ion Cyclotron Waves in Plasmas Immersed in Magnetic Fields 15 Jan. 1964 p 8-14 refs (See N64-17352 09-24) OTS: $2.60 ph, $1.10 mf

The following topics are discussed: (1) experimental studies of the dynamics of a current sheath and of magnetosonic oscillations; (2) analytical studies of a current sheath and of magnetosonic oscillations—numerical calculations of the current sheath's position, velocity, and possible magnetosonic oscillations; boundary-layer formation of the current sheath; and stability of a finite resistivity plasma. R.T.K.

N64-17355 Texas U., Austin Plasma Dynamics Research Lab.
RESONANCES AND WAVES IN ONE- AND TWO-ION SPECIES PLASMAS SUBJECTED TO INTENSE MAGNETIC FIELDS
Magne Kristiansen *In its* Propagation and Dispersion of Hydromagnetic and Ion Cyclotron Waves in Plasmas Immersed in Magnetic Fields 15 Jan. 1964 p 15-21 refs (See N64-17352 09-24) OTS: $2.60 ph, $1.10 mf

The basic equipment for experimental investigation of resonance effects in one- and two-ion-species plasmas was assembled and tested. A revised block diagram of the experimental arrangements is shown. The magnetic field arrangements and the RF excitation system are described. Some preliminary observations were made when the system was pulsed at hydrogen gas pressures ranging from 0.5 to 20 microns. The main effort centered around tuning the RF system for maximum power transfer into the plasma. A computer program was written for calculating the conditions for maximum power transfer at various assumed resistive plasma loadings. A study of the problem of calculating the effect of resonant ions interacting with the plasma sheath was initiated. R.T.K.

N64-17364 Lincoln Lab., Mass. Inst. of Tech., Lexington
THE REDUCTION OF ELECTROMAGNETIC BACKSCATTER FROM A PLASMA-CLAD CONDUCTING BODY
E. L. Murphy 23 Sep. 1963 26 p refs
(Contract AF 19(628)-500; ARPA Order 13; Proj. Defender)
(ESD-TDR-63-589; AD-430589)

This report considers a conducting body embedded in a collisionless ionized cloud and the possibility that the cloud acts to decrease the backscatter cross section of the object. An obvious process would be refraction. However, a less obvious process exists that can be described on the same mathematical basis as the plasma resonance, or space charge effect described by Herlofson for meteors. The essential change here is to include a conducting core within the plasma. Not only are the resonance shapes and locations affected but also the possibility then exists for a backscatter cross-section decrease considerably below the value of the conducting core itself. This "resonance-dip" phenomenon is described in some detail for the problem of a cylindrical or spherical conducting core surrounded by a uniform concentric dielectric layer. Author

N64-17445 Naval Research Lab., Washington, D.C.
SYNTHESIS OF NEW HIGH-TEMPERATURE MATERIALS WITH THE PLASMA JET
J. M. Hall Jul. 1963 15 p refs
(NRL-1490; AD-431797)

Chemical reactions in the plasma state offer promise for the synthesis of many new materials of interest to various high-temperature programs. A preliminary study was made to evaluate the plasma jet and the high-intensity carbon arc for this purpose, using injected powdered solids as reactants. The products sought included suboxides, intermetallics, metal-coated ceramic particles, and rare-earth nitrides, borides, and carbides. In spite of its extremely high peak temperature the plasma jet was found to be unsuitable for the purpose due to injection difficulties, insufficient dwell time, small volume of hot zone, and steep temperature gradients. The high-intensity arc shows more promise as a high-temperature reactor. Author

N64-17450 Mt. Auburn Research Associates, Inc., Cambridge, Mass.
COUPLING OF MAGNETOHYDRODYNAMIC TO ELECTROMAGNETIC AND ACOUSTIC WAVES AT A PLASMA-NEUTRAL GAS INTERFACE Scientific Report No. 1
S. L. Kahalas and D. A. Mc Neill 31 Oct. 1963 52 p refs
(Contract AF 19(628)-2836)
(AFCRL-63-944; AD-431635)

The coupling of magnetohydrodynamic waves to electromagnetic and sound waves at a plane interface between a plasma and a neutral gas is considered for arbitrary direction of the incident wave vector and for the constant external magnetic field lying either in the plane of incidence or perpendicular to it. The relations between the angle of incidence, reflection, and transmission, the ratio of the field amplitude transmitted or reflected to the corresponding amplitude incident, and the energy coupling coefficients are calculated. An incident fast magnetoacoustic mode generates a sound wave whose wave propagation vector makes an angle with the normal to the boundary of the order of the sound speed to Alfvén speed, when this ratio is small. An incident slow magnetoacoustic mode generates a sound wave with energy coupling coefficient of the order of unity, and an electromagnetic wave with energy coupling coefficient of the order of the ratio of the speed of sound to speed of light. Author

N64-17453 Texas U., Austin
RESEARCH ON PLASMA DIAGNOSTIC METHODS FOR HIGH TEMPERATURE PLASMA RESEARCH [Interim Technical Report]
Arwin A. Dougal Wright-Patterson AFB, Ohio, Aerospace Res. Labs. Jan. 1964 54 p refs
(Contract AF 33(657)-11073)
(ARL-64-6; AD-432170)

The following topics are discussed: (1) the use of far infrared radiation measurements for plasma diagnostics; (2) energy distributions of ions that escape through the mirrors; (3) diagnostics of experimental extreme-temperature plasma; (4) Faraday rotation of optical maser beams in high-density magnetoplasmas; and (5) a theory for optical maser diagnostics of ionized gases. R.T.K.

N64-17457 Ohio State U. Research Foundation, Columbus Antenna Lab.
OBLIQUE INCIDENCE ON GENERAL MAGNETO-PLASMA SLAB
H. Unz (Kansas U.) 15 Oct. 1963 23 p refs
(Contract AF 19(604)-7270)
(Rept. 1116-36; Sci. Rept. 21; AFCRL-63-943; AD-431888)

The problem of an arbitrary plane electromagnetic wave in free space, obliquely incident on a general magnetoplasma slab, is solved. The electromagnetic fields inside and outside the plasma slab are evaluated in terms of determinants, and the reflection and the transmission coefficients are found. Author

N64-17467 Princeton U., N.J. Plasma Physics Lab.
KINETIC THEORY OF A WEAKLY UNSTABLE PLASMA
E. Frieman and P. Rutherford 22 Apr. 1963 90 p refs
(Contract AT (30-1)-1238)
(MATT-179)

The evolution of a weakly unstable spatially uniform classical plasma is studied. Two methods are used. In the first method the nonlinear Vlasov equation is solved by a rigorous expansion technique with two small parameters $\gamma_k/\omega_k/E_k^2/n\kappa T$, where γ_k and ω_k are the growth rate and frequency of the unstable modes with wave vector k, and E_k is a typical amplitude of the electric field in the unstable modes. This leads to a quasi-linear theory in which mode coupling effects are important, and these are fully discussed. In the second method the problem is considered on the basis of a kinetic theory developed from the B-B-G-K-Y hierarchy of equations. In this case a further expansion parameter is $1/n\lambda_D^3$, where n is the number density and λ_D the Debye length. Author

N64-17470 Electro-Optical Systems, Inc., Pasadena, Calif.
PLASMA DIAGNOSTICS STUDIES FOR CROSSED FIELD ACCELERATORS

Andrew Proudian Mar. 1963 34 p refs
(Contract AF 49(638)-1063)
(EOS-RN-11; AD-415622)

The feasibility, advantages, and drawbacks of the following methods for diagnosing plasmas are discussed: (1) spectroscopic studies; (2) the use of particle beams; (3) microwave measurements; and (4) probe measurements. The gross characteristics of the plasma to which the diagnostic analysis applies are: the plasma static (gas) temperature is a few thousand degrees K; the static pressure is between 1 and 10 mm of mercury; and the electron density is between 5×10^{13} cm^{-3} and 5×10^{15} cm^{-3}. The plasma of interest is located between electrodes approximately 1 inch in length and breadth, and at a distance of approximately 1 inch from each other. A current of several hundred amperes is passing through the electrodes, and a magnetic field of 1 to 10 kg is applied in the usual $\bar{j} \times \bar{B}$ configuration. I.v.L.

N64-17495 Princeton U., N.J. Plasma Physics Lab.
SPECTROSCOPIC INVESTIGATION OF A WEAKLY IONIZED PLASMA IN A HELIUM HOLLOW CATHODE DISCHARGE
Joseph G. Hirschberg, Einar Hinnov, and Fritz W. Hofmann Sep. 1963 15 p refs Presented at the 6th Intern. Conf. on Ionization Phenomena in Gases, Paris, 1963
(Contract AT(30-1)-1238)
(MATT-236)

The spectrum of a helium cathode discharge tube has been studied in the visible and vacuum ultraviolet regions. Doppler temperatures of ion and representative neutral lines were calculated from line profiles measured with a photoelectric Fabry–Perot interferometer. Approximate electron densities and temperatures are deduced from the gross features of the observed distribution of excited states. Dominating processes producing some of the details of the neutral helium excitation are proposed. Author

N64-17502 Princeton U., N.J. Plasma Physics Lab.
ENERGETIC ELECTRONS FROM A BEAM-PLASMA OVERSTABILITY
Thomas H. Stix Feb. 1964 70 p refs
(Contract AT(30-1)-1238)
(Matt-239)

Considered is the interaction of an electron beam of moderate energy (typically 5 to 20 kev) with a warm fully-ionized plasma (temperatures typically in the range 2 to 20 ev) immersed in a static magnetic field (for example, $B_0 = 2000$ gauss). It is assumed that the density of electrons in the beam is small ($\lesssim 1\%$) compared to the density of electrons in the main plasma. In laboratory experiments that were operated under such conditions there have been observed emissions of X-rays with energies exceeding 100 kev. These X-rays come from high-energy electrons striking the wall of the apparatus—electrons that have been accelerated by some process taking place in the plasma. One such process is investigated in considerable detail. Author

N64-17527 California U., Berkeley Engineering Research Inst.
COMPUTATION AND MEASUREMENT OF HALL POTENTIALS AND FLOW FIELD PERTURBATIONS IN MAGNETOGASDYNAMIC FLOW OF AN AXISYMMETRIC FREE JET
David R. Otis (Ph.D. Thesis) 10 Jan. 1964 96 p refs
(Contract AF 49(638)-502; Contract Nonr-222(45))
(AS-64-1; AD-431761)

The interaction was observed between a supersonic free jet of partially ionized argon and the magnetic field of a coil concentric with the jet. Nominal values of the parameters were: Mach number, 3; Reynolds number, 1,000; magnetic Reynolds number, 0.2; magnetic interaction parameter, 1; Hall parameter, 1. The jet was strongly channeled. Axial and radial electric fields were observed in the jet with a net rise in potential across the interaction. These observations were consistent with predictions based on the single-fluid, macroscopic equations, and a simple slug flow model. The current equation was solved to second order in the Hall parameter, giving a closed-form expression for the Hall potential that agreed with the experiments for weak fields. Flow perturbations were calculated for Mach numbers of 3.11, 6.08, and 10.05 by applying the method of characteristics to the linearized equations for a nonviscous, compressible fluid, neglecting Hall currents. Author

N64-17584* Stanford U., Calif. Radioscience Lab.
A MODEL FOKKER-PLANCK EQUATION FOR A PLASMA AND ITS SOLUTION
J. P. Dougherty (Cambridge U.) [1964] 35 p refs
(NASA Grant NsG-377)
(NASA-CR-53200; SEL-64-003) OTS: $3.60 ph, $1.25 mf

A model Fokker–Planck equation is discussed for a single species of particles in a plasma. This equation has several properties in common with the real equation, and ascribes an approximately correct behavior to most of the particles, though it is incorrect for the high-energy tail in the thermal distribution. It is shown that the equation can be solved completely for the small perturbations of a uniform plasma by an electric field harmonic in space and time in an external magnetic field. Applications to ionospheric radar scattering are briefly discussed; it is shown that in certain circumstances ion–ion collisions can have a profound effect on the scattering, even though the collision frequency is much smaller than the ion gyrofrequency. Author

N64-17651 Yale U. Observatory, New Haven, Conn.
INTERACTION OF RADIATION AND MATTER IN A PLASMA [Interim Technical Report]
Ludwig Oster Wright-Patterson AFB, Ohio, Aerospace Res. Labs., Feb. 1964 20 p refs
(Contract AF 33(616)-7271)
(ARL-64-24; AD-432824)

A summary is given of the present state of the investigations carried out on interactions between radiation and matter in a plasma. In particular, results based on a new transfer equation of radiation in dispersive media, and a discussion of some practical, interesting cases of departures from local thermodynamic equilibrium in continuous energy states are given. Author

N64-17655 Battelle Memorial Inst., Columbus, Ohio
PLASMA WELDING AND CLEANING
H. E. Pattee, M. D. Randall, and D. C. Martin Huntsville, Ala., Army Missile Command, 24 Feb. 1964 68 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-123; AD-432808)

Plasma technology, as it applies to joining metals, is reviewed, and the current status of both welding and cathodic cleaning of metals by plasma arc procedures is summarized. In order to produce defect-free welds, with high joint efficiencies in aluminum alloys by TIG welding procedures, very slow welding speeds, or specialized methods, must be used. Although application of the plasma arc to joining metals is still largely in the development stage, it appears to be an attractive welding process. The plasma arc is constricted whereas the TIG arc is unconfined. Because of the constriction, higher temperatures

are available in the plasma arc. Thus, substantially higher welding speeds can be achieved than with the TIG process. The effectiveness of cathodic cleaning has been demonstrated by surface resistivity measurements. Author

N64-17709* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ORIGIN OF OH CHEMILUMINESCENCE DURING THE INDUCTION PERIOD OF THE H_2-O_2 REACTION BEHIND SHOCK WAVES
F. E. Belles and M. R. Lauver Repr. from J. Chem. Phys., v. 40, no. 2, 15 Jan. 1964 p 415-422
(NASA-RP-145)

The intensity and the rate of increase of light emitted by the $OH^*{}^2\Sigma^+ \rightarrow {}^2\Pi$ (0–0) transition were studied during the induction period behind shock waves in 5% H_2–95% air mixture. Induction-zone temperatures ranged from about 1,000° to 1,900° K, and the initial pressure was 10 torr. A standard lamp was used to calibrate the optical system, so that photomultiplier signals could be transformed to OH^* concentration. The results are interpreted in terms of radical-recombination reactions. It is found that OH^* is formed in the reaction $H+O_2+H_2 \rightarrow H_2O+OH^*$ and is effectively quenched, in these experiments, only by water. The excitation process is an inefficient reaction, with an average rate constant of 2×10^5 liter^2/mole^2 sec. Author

N64-17776 Princeton U., N.J. Plasma Physics Lab.
EXCITATION OF ELECTROSTATIC OSCILLATIONS IN A MAGNETIC FIELD
Francis F. Chen Jan. 1963 106 p refs
(Contract AT(30-1)-1238)
(MATT-242)

The purpose of this tract is twofold: first it is to assemble and condense the results of the cold-plasma approach to the problem and to present them in such a way that the approximations and physical ideas involved are made clear. Second, it is to present a new calculation of the growth rates of various electrostatic interactions in the case of zero temperature, compare it with results obtained by others, and summarize the available results on this particular problem. Author

N64-17777 Princeton U., N.J. Plasma Physics Lab.
A NOTE ON THE PLASMA EQUATION OF STATE
Fred Shure Feb. 1964 5 p ref
(Contract AT(30-1)-1238)
(MATT-254)

It is shown that the equation of state for an electron gas in a positive background follows straightforwardly from the truncated Liouville hierarchy. The results obtained agree (to the extent to which three-particle correlations may be neglected) with the results of Abe, Friedman, and Guernsey obtained by other methods. The effects of higher-order correlations are being considered. Author

N64-17787 Avco-Everett Research Lab., Everett, Mass.
DETAILED THEORETICAL AND EXPERIMENTAL STUDY ON A LARGE MHD GENERATOR
J. F. Louis, G. Gal, and P. R. Blackburn Mar. 1964 27 p refs
(Avco-Everett Res. Rept.-174)

The experimental results were obtained in an MHD channel (Mark II B) having a ratio of outlet to inlet areas of 2.5. The mass flows, Hall coefficient, and the number and width of the electrodes were changed systematically to determine the parameters influencing the performance of the generator. At large mass flows, supersonic flows were attained and resulted in a substantial increase of power output and efficiency. The location of the shock, its strength as influenced by boundary-layer separation, and the length of the separated region are studied. At low mass flows and large relative interaction, the subsonic flow diffuses in divergent channels; the power output of the downstream electrodes becomes small. Electrical boundary layers exist on the walls. On the highly cooled insulating walls, the conductivity vanishes in the inner boundary layer and the Hartmann effect is negligible. The electrode wall operates at a temperature close to the gas temperature, the gas conductivity is finite, and the Hall field is shorted locally by the electrodes. The shorting of the Hall field at the surface of the electrodes occurs in an electrical boundary and produces losses that depend on the value of $\omega\tau$ and the geometry of the electrodes. Author

N64-17816* Rice U., Houston, Tex.
RESEARCH ON IONIZATION PHENOMENA IN HYPERSONIC WIND TUNNELS Final Report, 1 Apr. 1959-1 Mar. 1964
Alan J. Chapman and Herbert K. Beckman 1964 39 p refs
(NASA Grant NsG-3-59)
(NASA CR-53363) OTS: $3.60 ph, $1.37 mf

Abstracts of twenty investigations are presented dealing with the development of a blowdown wind tunnel section. This section is supplied with a high-energy, partially ionized monatomic gas (helium or argon) flowing uniformly at hypersonic speed, and whose thermodynamic, chemical kinetic, and gas dynamic stages are reliably determined. I.v.L.

N64-17829* National Aeronautics and Space Administration. Ames Reserach Center, Moffett Field, Calif.
SHOCK-LAYER RADIATION OF BLUNT BODIES AT REENTRY VELOCITIES
William A. Page and James O. Arnold Washington, NASA, Apr. 1964 45 p refs
(NASA TR R-193) OTS: $1.25

Measurements are presented of the thermal radiation from shock layers of models simulating vehicles entering the earth's atmosphere. The data are analyzed, and the contribution of radiative heating to the total heating loads imposed upon entry vehicles is evaluated. The models were launched by light-gas guns into still air or into a countercurrent airstream generated by a shock-tube-driven hypersonic wind tunnel. Velocities ranged from 5.4 to 12.4 km/sec, some 1.5 km/sec above the velocity for earth escape, and free-stream densities were varied over a range of 1000 to 1, from $\rho_\infty/\rho = 2 \times 10^{-4}$ to 2×10^{-1}. Various types of radiometric measurements led to estimates of the total radiation and the spectral distribution of the radiation. Measurements of the thermal radiation emitted from the nonequilibrium reaction zone directly behind the bow shock give characteristic radiative heating fluxes of 2, 6, and 18 watts/cm^2 for velocities of 6.4, 9.5, and 11.0 km/sec, respectively. Also included is a discussion of methods for predicting radiative heating of full-scale vehicles. Author

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-16956 Harvard U., Cambridge, Mass. Div. of Engineering and Applied Physics
STRESS EFFECTS ON INSULATOR TO METAL TRANSITIONS. I. V_2O_3 II. VANADIUM SPINELS
Julius Feinleib 12 Dec. 1963 255 p refs
(Contract Nonr-1866(10))
(HP-11; AD-431609)

The resistivity in the metal phase of single crystal V_2O_3 of good stoichiometry is found to be of the order of 10^{-4} ohm/cm and to increase linearly with temperature from the transition near 150° K to about 350° K. There is an anomalous rise in resistivity near 525° K, and then the resistivity resumes its increase with temperature with the same slope. In the semiconducting region of behavior, below 142° K, the resistivity is measured to be about 10^8 greater than that in the metallic region, and it decreases with temperature with an activation energy of about 0.15 ev. The effects of pressure are to decrease the metallic phase resistivity, to decrease the activation energy of the semiconducting phase, and to decrease the transition temperature from metal to insulator. The dependence of the transition temperature on uniaxial stress was measured and found to be anisotropic. Pressure measurements of vanadium spinels showed that, assuming reasonable compressibilities for these materials, there is no sharp change in the activation energy as the critical vanadium ion separation is approached. R.T.K.

N64-16962 Johns Hopkins U., Silver Spring, Md. Applied Physics Lab.
AN ANNOTATED BIBLIOGRAPHY OF SOVIET LITERATURE ON MASERS AND LASERS
E. J. Blau 15 Sep. 1963 69 p 231 refs
(Contract NOw-62-0604-c)
(TG 230-B1; AD-421701)

The purpose of this annotated bibliography is to list and abstract all of the Soviet literature, published before 1963, that deals directly with masers and lasers. Articles that serve as partial foundation and general background to the subject have been omitted. The earliest reference is the doctoral dissertation by V. Z. Fabrikant, dated 1939. R.T.K.

N64-16990 Sylvania Electric Products, Inc., Waltham, Mass.
ACTIVE THIN FILM TECHNIQUES MICROMIN PROGRAM Sixth Interim Development Report, 1 Nov. 1963-31 Jan. 1964
Egons Rasmanis, James Cline, and Robert Tiernan 6 Mar. 1964 56 p refs
(Contract NObsr-87633)
(AD-431749)

The silicon depositions were carried out for the control of n-type doping, Hall measurements, improvement of crystallinity by annealing and by electron beam heating, and fabrication of improved diodes and transistors. Diodes with ohmic contacts were made with reverse breakdowns of 15 to 60 volts. The apparatus for Hall and resistivity measurements was improved, resulting in reliable and reproducible data on mobilities and carrier concentrations. The patterns for the Hall resistivity silicon deposition mask and the photoresist mask were changed so that both resistivity and Hall measurements could be made in a single operation. Improved crystalline quality in silicon thin films has been obtained through high-temperature annealing. Initial vacuum-deposited films exhibited increased grain size and Laue spots, and pyrolytic films yielded <111> orientation with grain sizes to >200 micron diameter. A detailed study of this process was initiated that utilized a metallograph-mounted vacuum furnace with an observation window. Author

N64-16991 Stanford U., Calif. Solid-State Electronics Lab.
DIFFUSION AND SOLUBILITY OF IMPURITY ELEMENTS IN COMPOUND SEMICONDUCTORS Final Report
G. L. Pearson Dec. 1963 10 p refs
(Contract DA-04-200-ORD-1087; Contract DA-ARO(D)-31-124-G338)
(AROD-2895; SEL-63-147; AD-430994)

Research in the following areas is discussed: (1) diffusion, solubility, and distribution coefficient of impurity elements in semiconductors composed of group III and group V elements; (2) development and fabrication of subnanosecond gallium arsenide switching diodes; (3) electrical properties of thin-diffused layers of zinc in gallium arsenide; and (4) point defects in semiconducting materials. R.T.K.

N64-17034 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A STUDY OF DIFFUSION IN AN IRON-ALUMINUM SYSTEM WITHIN A WIDE RANGE OF CONCENTRATIONS
S. D. Gertsriken, I. Ya. Dekhtyar, N. P. Plotnikov, L. F. Slastnikova, and T. K. Yatsenko *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 116-130 refs (See N64-17026 09-18)

Experiments carried out to define the connection between the diffusion parameters and the magnitudes characterizing the interatomic bonds are discussed. The diffusion of iron was investigated in iron-aluminum alloys containing 1.7%, 4%, 7%, 13%, and 34.5% Al by weight, and it was found that the diffusion coefficients of iron increased gradually with the concentration of aluminum. The diffusion coefficients of cobalt in iron-aluminum alloys with an Al content of 1.7%, 4%, 7%, 11%, 13%, 21%, 26%, 30%, and 34.5% by weight were measured and found to be independent of the concentration. A comparison of the results obtained in the study of mutual diffusion in iron-aluminum alloys with the phenomenon of self-diffusion of iron in the alloys in discussed. It was found that, in a zone ranging up to about 25 atom % of aluminum, the magnitude of the activation energy of diffusion varies little but rises sharply with further increase in aluminum content. A similar pattern for the dependence of the activation energy of cobalt diffusion was observed. The activation energy of diffusion of iron was found to vary little in the zone of aluminum concentrations up to 25 atom %. P.V.E.

N64-17035 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DETERMINATION OF THE PARAMETERS OF DIFFUSION AND DEFORMATION IN NICKEL-CHROMIUM ALLOYS
I. Ya. Dekhtyar and V. S. Mikhalenkov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 131-155 refs (See N64-17026 09-18)

The dependence of the activation energy of diffusion on the chromium concentration agrees with theoretical speculation as to the character of the atomic interaction in alloys based on elements of the transition group. The activation energy of diffusion increases with the increase in chromium concentration and attains maximum values at ~ 15 atom% Cr, at which the vacant sites of the electron *d* shells are filled to the maximum extent. From the data on diffusion, the average temperature coefficient of the modulus of elasticity for the investigated alloys was estimated to be $8.55 \cdot 10^{-4}$ degree $^{-1}$. A device was designed and a method was developed for the study of diffusion parameters during plastic deformation at high temperatures. It was discovered that the diffusion coefficients rise with an increase in the deformation rate $\dot{e}$ proportionally to $\dot{e}^2$. An expression was found for the coefficient of softening of a material at high temperature under load. Author

N64-17038 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

DIFFUSION IN NICKEL-BASE SOLID SOLUTIONS

Yu. F. Babikova and P. L. Gruzin *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 191–197 refs (See N64-17026 09-18)

The diffusion of chromium in nickel–chromium alloys (10% to 28%) was studied, and it was found that the self-diffusion coefficients of nickel and the diffusion coefficients of chromium for these alloys have approximately the same values in high-temperature zones. It was shown that intensive recovery in nickel–chromium alloys takes place at a diffusion level of the order of 10^{-13}cm^2-sec^{-1} The diffusion level of solid solutions corresponding to the diffusion coefficients of the basic elements of the given magnitude may be tentatively called the threshold level of the diffusion mobility of intensive recovery in heat-resistant alloys, intended for short-time service at high temperatures. A rough estimate can be made of the potential level of heat resistance of solid solutions from data obtained from the calculation of diffusion coefficients. Author

N64-17039 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A STUDY OF INTERGRANULAR DIFFUSION IN METALS AND ALLOYS

V. I. Arkharov, C. M. Klotsman, A. N. Timofeyev, and I. I. Rusakov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 198–207 refs (See N64-17026 09-18)

Experiments carried out to determine the effect of small additions of antimony upon the parameters of intercrystalline diffusion of silver in copper are discussed. The study was carried out by making a radiometric study of the diffusion of silver in polycrystalline copper in an alloy of copper and 0.4% antimony. It was found that antimony accelerates the intragranular diffusion of silver and that the length of the protrusions on the diffusion front in copper alloyed with 0.4% silver is of an order greater than in pure copper. P.V.E.

N64-17040 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A STUDY OF THE EFFECT OF THE MUTUAL ORIENTATION OF CRYSTALS ON INTERCRYSTALLINE DIFFUSION AND INTERNAL ADSORPTION

V. I. Arkharov and A. A. Pentina *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 208–246 refs (See N64-17026 09-18)

A study into the effects of the mutual orientation of crystals upon intercrystal-line diffusion in pure metal and also in the same metal when it contains a horophyle additive is discussed. The study is divided into the following areas of interest: (1) structural inhomogeneities and their effect on physical properties; (2) effect of the mutual orientation of crystals on the amount of excess energy in intercrystalline transition zones and on intergranular diffusion; and (3) dependence of intercrystalline orientation on the penetration depth of the diffusing substance along intercrystalline boundaries. P.V.E.

N64-17041 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STUDY OF ATOMIC INTERACTION IN ALLOYS BY ANALYSIS OF X-RAY SCATTERING FROM THE CRYSTAL LATTICE

V. V. Geychenko, M. A. Krivoglaz, and A. A. Smirnov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 247–262 refs (See N64-17026 09-18)

A study dealing with the diffuse scattering of X-rays by alloys of various kinds (substitutional and interstitial) is discussed, and formulas are derived that are applicable to the study of radiation of other types of waves (electrons and neutrons). The formulas that are derived relate the atomic interaction constants to the diffuse background intensity. An investigation of diffuse scattering of X-rays in substitutional alloys by the method of fluctuations is also discussed. P.V.E.

N64-17043 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CALCULATING THE ABSOLUTE VALUE OF THE SELF-DIFFUSION COEFFICIENT AT GRAIN BOUNDARIES AND OF THE BOUNDARY WIDTH

S. Gertsriken and D. Tsitsiliano *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 280–289 refs (See N64-17026 09-18)

Self-diffusion along the boundaries of grains of silver was investigated, and absolute diffusion factors were determined, i.e., without any arbitrary assumptions regarding the boundary widths. The coefficients of the self-diffusion of silver along the boundaries conform to the relationship $D_{rp} = 1.5 \cdot 10^{-4}\exp(-20{,}300/RT$. The boundary width in silver was also evaluated and was shown to be several hundred A, not 5 A as previously assumed. Author

N64-17049 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

DEFORMATION MECHANISM OF SINGLE CRYSTALS OF ALUMINUM AT VARYING TEST TEMPERATURES

L. I. Vasil'yev, Tsen Ling-Chao, and Yang Ta-Yu *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 375–405 (See N64-17026 09-18)

The structure of deformed single crystals, like the flow stress, is not a single-value function of temperature at the moment of testing. A considerable part is played by the prestrain temperature. Prior low-temperature extension with subsequent high-temperature deformation produces a number of characteristic structural changes in the single crystal (numerous breaks in the slip bands, the dispersed nature of these bands, greater density of the deformation bands, etc.). The influence of prior high-temperature deformation is revealed, in the course of subsequent low-temperature tests, in the typical rough relief pattern (number and appearance of deformation bands). A qualitative correspondence was observed to exist between the effects of temperature variations on the change in mechanical properties (flow stress) and on the relief pattern (deformation mechanism) of the crystal during the course of extension. Author

N64-17050 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

HARDENING AND SOFTENING MECHANISM

A. M. Yuferov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 407–423 refs (See N64-17026 09-18)

The distribution of forces interacting between the atoms of two lattices in a plane perpendicular to their border is discussed. From the discussion, it is concluded that the lattice in an undeformed metal is distorted most at the grain boundaries, and the distortion values of the lattice parameter decrease toward the center of the grain that remains undeformed. The local forces appear after deformation in the shear planes. Their magnitude begins lower than the undeformed metal, but the number of their zones of activity is higher. Since the thickness of the slip bundles, as compared with the size of undeformed grains, is very small, the lattice, despite the decrease in local forces, is distorted over almost its entire structure; the average value of the distortion of the lattice increases in spite of the lower absolute values of the maximum distortions. P.V.E.

N64-17053 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE THEORY OF DILUTE SOLID SOLUTIONS

I. B. Borovskiy and K. P. Gurov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 447–461 refs (See N64-17026 09-18)

The changes in the characteristics of X-ray spectra of chromium as a function of its purity (using hydrogenized, electrolytic, and iodized chromium) was studied, along with the influence of molybdenum admixtures on the characteristics of the electrolytic chromium X-ray spectrum. It is concluded that in the alloying of transition metals with small amounts of admixtures, there is an optimum zone at admixture concentrations of the order of 0.05 to 0.1 w/o, and that, at high temperatures, only a certain class of admixtures (those with excess negative charge with respect to that of the atom framework of the metal base) retain their alloying properties. P.V.E.

N64-17054 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INFLUENCE OF THE THERMAL VIBRATION OF ATOMS ON THE ELECTRON SPECTRUM OF METALS AND ALLOYS

I. B. Borovskiy and G. N. Ronami *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 462–469 refs (See N64-17026 09-18)

An investigation into the influence of small amounts of alloying elements on the "melting away" of the fine structure of the absorption spectra is discussed. The investigation led to the following conclusions: (1) Besides the well-known phenomenon of "melting away" of the fine structure on the short-wave side of the basic absorption edge, a change in the structure and in the basic absorption edge itself takes place with an increase in temperature. The process of dispersion (minor perturbance) influences not only the frequencies and amplitudes of vibrations but also the whole energy spectrum of the crystal lattice of a metal. (2) The intensity of the "melting away" of the fine structure of the absorption spectrum and of the basic absorption edge itself in lead and in lead–tin alloys, during an increase in temperature, depends on the percentage of alloying element. P.V.E.

N64-17056 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ELECTRODISPLACEMENT IN METALLIC SOLID SOLUTIONS

K. P. Romadin *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 491–497 refs (See N64-17026 09-18)

The migration of alloy components takes place when a direct current is passed through a metallic solid solution. The disturbance of a balanced system by passing a direct current through it causes a movement of the alloy components, the ion with the greater charge density moving to the cathode. On the basis of the theory of the metallic state, the processes of diffusion in metallic solid solutions should be viewed as processes of dissociation. The diffusion flow should be considered a flow of ions rather than of atoms. Author

N64-17063 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A THEORY OF THE BINDING ENERGY OF OXIDES OF TRANSITION METALS

A. N. Men' and A. N. Orlov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 616–629 refs (See N64-17026 09-18)

An approximate analytical formulation of the results of quantum mechanical evaluations of the binding energy of ions of transition metals in octahedral and tetrahedral interstices (O- and T-points) in oxide lattices with a cubic structure has been advanced. An approximate expression for the free energy was obtained, and a form of the temperature dependence of the equilibrated number of ions of various types and valences in the O- and T-points was found. As an illustration of the general results obtained, the dependence of the equilibrated number of vacancies on the concentration of an admixture of another metal was investigated in a spinel-type lattice, and an explanation was supplied for the existence of a nonstoichiometric oxide of $Fe_{1-x}O$ composition in a lattice of the rock-salt type. Author

N64-17064 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ELECTRO-DIFFRACTION STUDY OF PHASE CHANGES IN THIN METAL AND OXIDE FILMS

D. V. Ignatov *In its* Invest. of Heat Resistant Alloys 19 Jun. 1963 p 630–642 refs (See N64-17026 09-18)

Discussed are the results of an electron-diffraction study of the phase changes relative to temperature and length of heating that take place in oxide films on aluminum, in an iron-aluminum system, and in the oxide systems $NiO-Cr_2O_3$ and $NiO-Al_2O_3$. From the results of the study it is concluded that the electron-diffraction method can be successfully applied to the study of phase transitions in thin free films of complex composition, in surface films on metals and alloys, and along interphase boundaries, in the same way as the X-ray method is used to study phase transitions within the body of the substance concerned. P.V.E.

N64-17124 Stanford Research Inst. Menlo Park, Calif.

SOLUBILITY OF METAL OXIDES IN SUPERCRITICAL AQUEOUS SOLUTIONS. Final Report, Jun. 1, 1962-Oct. 31, 1963

W. J. Silva and R. C. Smith, Jr. 1963 46 p refs

(Contract AF 19(628)-392)

(AFCRL-64-38; AD-431182)

An effort has been made to elucidate some of the basic processes underlying the growth of single crystals from hydrothermal solutions. The study chiefly concerns measurements of the solubility of rutile in supercritical water and basic media in the temperature range 375° to 525° C under solution pressures of 5,000 to 33,000 psi. The laboratory equipment used in such measurements is described, and a method for measuring the equilibrium densities of the solutions is discussed. A fundamental equation is derived that, with the use of the Van't Hoff equation, permits calculation from only a few measurements of the solubility of metal oxides in basic hydrothermal solutions. Results of this work and recently published data on ZnO, Al_2O_3, and BeO are correlated and used to demonstrate the applicability of the equation. Author

N64-17228 Bureau of Mines, Norris, Tenn.

THE SYSTEM MAGNESIA-MAGNESIUM FLUORIDE-GERMANIA-LITHIUM FLUORIDE, 6.94 PERCENT LITHIUM FLUORIDE

George R. Mc Cormick 1964 15 p refs

(BM-RI-6398)

Because several new and unusual synthetic minerals were found in the system $MgO-MgF_2-SiO_2$ with Li^+ or Na^+ a similar system with GeO_2 replacing SiO_2, plus Li^+ was investigated. In addition to the expected compounds of germanium, Ge-fluor-hectorite and a Ge-fluor-chrysotile were synthesized. Protoamphibole was not observed. Data are given for 69 compositions prepared in the system $MgO-MgF_2-GeO_2$ at 6.94-percent LiF. Author

N64-17230 Clemson U., S.C.
A STUDY OF THE CRYSTALLINE TRANSFORMATION IN $LiAl_5O_8$ Technical Documentary Report, May 1962-Sep. 1963
H. H. Wilson Wright-Patterson AFB, Ohio. AF Materials Lab., Jan. 1964 21 p refs
(Contract AF 33(616)-6870)
(RTD-TDR-63-4151; AD-431188)

A study was made of the high-temperature phase change that occurs in $LiAl_5O_8$. The reaction has been reported to be either an order–disorder transformation or a reconstructive polymorphic inversion. Kinetics of the phase change with respect to compositional, temperature, and time variables were studied. The spinel structure was found to exist over wide compositional ranges in both lithia-rich and lithia-poor regions. The degree of the defectiveness of the structures affected the transformation rates. The transformation process is diffusion controlled and requires a small activation energy. Insufficient evidence was obtained to resolve the question of the type of change that occurs. Author

N64-17254 Oak Ridge National Lab., Tenn.
THE PRODUCTION OF LiF SINGLE CRYSTALS WITH SELECTED ISOTOPIC RATIOS OF LITHIUM
C. F. Weaver, R. G. Ross, B. J. Sturm, J. E. Eorgan, and R. E. Thoma Mar. 1964 48 p refs
(Contract W-7405-ENG-26)
(ORNL-3341) OTS: $1.25

The purpose of this research was to develop the techniques and apparatus necessary to produce single crystals of LiF with selected ratios of the lithium isotopes containing not more than a few parts per million impurities. The starting material was prepared from purified aqueous solutions of LiOH and HF and was dehydrated in the molten state with anhydrous HF. The dehydrated LiF was then converted into a single crystal in a Stockbarger furnace. Crystals weighing several hundred grams and containing 99.99, 98.06, and 96.50 a/o lithium-7 have been produced as part of a sequence that will include 87.60, 79.28, 69.24, 50.77, and 0.7 a/o lithium-7. These crystals do not display strain under polarized light and do not show OH^- absorption of infrared radiation. Author

N64-17265 International Union of Pure and Applied Chemistry, Basle (Switzerland) Commission on High Temperatures and Refractories
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS IN THE CONDENSED STATE, OCTOBER, NOVEMBER, DECEMBER 1963, VOLUME 1963, NUMBER 4
J. J. Diamond (Natl. Bur. of Standards), ed. [1963] 49 p refs

A bibliography, pertinent to the following categories, is presented: (1) devices for achieving temperatures above 1,000° C; (2) devices for measuring and controlling temperatures above 1,500° C; (3) devices for physical measurements at temperatures above 1,000° C; (4) the properties, at temperatures below and above 1,000° C, of metallic, nonmetallic, and mixed materials that melt above 1,500° C; (5) the properties, at temperatures above 1,000° C, of metallic and nonmetallic materials that melt below 1,500° C; (6) phase equilibria; and (7) reactions at temperatures above 1,000° C. I.v.L.

N64-17278 Denver Research Inst., Colo.
RESEARCH ON THE SAMARIUM-TYPE INTERMEDIATE PHASES OF INTRA-RARE-EARTH BINARY SYSTEMS Technical Report No. 2 [1 Jan.-31 Dec. 1963]
Charles E. Lundin and J. F. Nachman Jan. 1964 26 p refs
(Contract Nonr-3661(02))
(DRI-2141; AD-4300961)

Five new binary intra-rare-earth systems have been investigated to confirm the existence of the samarium-type intermediate phase. These systems are: La-Ho, Ce-Gd, Ce-Ho, Nd-Gd, and Nd-Ho. The systems were studied primarily by metallography and X-ray diffraction techniques. The limits of the single-phase terminal solid solutions and the two-phase regions were determined. Lattice parameters for the intermediate phases were determined, and the approximate composition of each has been established. A complete metallographic analysis of the phase equilibria in each system is presented. The position of the intermediate phase correlates well with a size effect factor of the two components in each respective system. Author

N64-17343 Joint Publications Research Service, Washington, D.C.
EXCITING A LIGHT SOURCE WITH A COMMON AXIS PULSE LASER
Hsu Chi-jen, Chang Tsun-k'uei et al *In its* Transl. on Communist China's Sci. and Technol. No. 75 19 Mar. 1964 p 29–40 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 11, 1963 p 39–41 (See N64-17342 09-01) OTS: $2.25

A new, common-axis, cylindrical, xenon flash lamp for exciting a light source for a ruby light, quantum oscillator is described. The lamp is designed to match a 4-cm-long and 0.5-cm-diameter ruby rod. The lamp tube is made of "Pa-li-k'o-ssu" glass or crystal material. The input energy of the glass lamp is up to 800 Joules, whereas that of the crystal lamp can be raised to more than 3,000 Joules. Pure nickel is used as the electrodes. The lamp was observed to have the following advantages: (1) It provided high flash power and high efficiency without an axial magnetic field. (2) The energy was higher than that of a linear tube lamp with the same electrode interval. (3) The structure was tight. (4) It is an ideal tool for theoretical study. I.v.L.

N64-17344 Joint Publications Research Service, Washington, D.C.
RUBY S-SERIES ABSORPTION SPECTRUM TESTS
Lu Ta-yuan, Yu Wen-yen, and Plen Hsi-tou *In its* Transl. on Communist China's Sci. and Technol. No. 75 19 Mar. 1964 p 41–43 refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 11, 1963 p 45–46 (See N64-17342 09-01) OTS: $2.25

The ruby S-series spectral line refers to the acute-absorption line series caused by the splitting of the $^2F_1$ energy level of the chromium ion (Cr^{3+}) in ruby. This series spectrum was investigated. Results indicate that: (1) The line observed as W. Low's so-called S_3 line (vicinity of 15,200 cm^{-1}) was not a single line but a double line that was recorded as $S_{\frac{3}{2}}$ and $S_{\frac{3}{2}}$. The wavelengths were 6,583A and 6,573A at 77° K, when E of the projected light was perpendicular to the C_3 axis. (2) The W. Low's so-called S_1 line was not a spectral line but a line group. Testing with samples of different concentrations proved that this line group had something to do with the coupling effect of chromium ion in the crystal, and it seemed that it could not be considered as $^4A_2$ leaping to $^2F_1$. (3) The result of this investigation and the result of the theoretical calculation by S. Sugano and M. Peter were quite close. However, the investigated value showed a relatively large difference when compared to the test result made by W. Low. I.v.L.

N64-17441 Minneapolis-Honeywell Regulator Co., Hopkins, Minn. Honeywell Research Center

MICROSTRUCTURE AND MECHANICAL PROPERTIES OF CERAMICS

R. J. Stokes May 1963 70 p refs Presented at the 65th Ann. Meeting of Am. Ceramic Soc., Pittsburgh, 27–28 Apr. 1963
(Contract Nonr-4076(00))
(HR-63-264; Tech. Rept. 19; AD-407614)

In this review paper the influence of microstructure on the following aspects of mechanical behavior has been considered: (1) elastic deformation, (2) anelastic behavior, (3) plastic deformation, (4) brittle fracture, and (5) high-temperature deformation and creep. In addition to familar variables such as grain size and the presence and distribution of porosity or a second phase, the term microstructure has been considered broadly enough to allow discussion of the role that fundamental variables such as crystal structure, bond character and crystalline defects, impurities, vacancies, and dislocations play in determining mechanical behavior. Author

N64-17446 Franklin Inst., Philadelphia, Pa. Labs. for Research and Development

DEFORMATION CHARACTERISTICS OF THIN FOILS AND COMPOSITES Final Report

Alan Lawley, Horace L. Gaigher, and Sidney Schuster Jan. 1964 85 p refs
(Contract Nonr-2992(00))
(F-A2366; AD-430902)

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1. TENSILE BEHAVIOR OF COPPER FOILS PREPARED FROM ROLLED MATERIAL p 1–31 refs (See N64-17447 09-25)

2. DISLOCATION CONFIGURATIONS IN ZONE-MELTED SINGLE CRYSTAL MOLYBDENUM p 32–81 refs (See N64-17448 09-25)

N64-17447 Franklin Inst., Philadelphia, Pa. Labs. for Research and Development

TENSILE BEHAVIOR OF COPPER FOILS PREPARED FROM ROLLED MATERIAL

Alan Lawley, Horace L. Gaigher, and Sidney Schuster *In its* Deformation Characteristics of Thin Foils and Composites Jan. 1964 p 1–31 refs (See N64-17446 09-25)

The tensile behavior of copper foils prepared from rolled bulk material has been studied over the thickness range 2μ to 53μ, and for a wide range of grain sizes. For foils of comparable grain size, having the cube texture and tested along $<100>$, yield strength increases with decreasing foil thickness t below $\sim 26\mu$, with a corresponding decrease in ductility. Yield stresses ~ 9 kg-mm^{-2} are observed for 2μ foils compared with values <2kg-mm^{-2} for bulk polycrystalline copper. Deformation occurs in the form of localized slip clusters distributed throughout the gage section. To the extent that the tensile strength (10 to 18 kg-mm^{-2}) is unaffected by foil thickness, and that the foils possess fair ductility, the stress–strain behavior resembles that of bulk material rather than that of whiskers or evaporated films of comparable dimensions. The dependence of yield strength σ_y on foil thickness t below $\sim 26\mu$ is of the form: $\sigma_y = \sigma_o + kt^{-1/2}$. Possible explanations for the stress increase are considered. Author

N64-17448 Franklin Inst., Philadelphia, Pa. Labs. for Research and Development

DISLOCATION CONFIGURATIONS IN ZONE-MELTED SINGLE CRYSTAL MOLYBDENUM

Alan Lawley, Horace L. Gaigher, and Sidney Schuster *In its* Deformation Characteristics of Thin Foils and Composites Jan. 1964 p 32–81 refs (See N64-17446 09-25)

Single crystal molybdenum, deformed in tension at temperatures in the range of 4.2° to 300° K, was studied. It was found possible to correlate the bulk stress–strain behavior with the observed glide dislocation configurations. In addition to studying the glide dislocation configurations, a detailed examination was made of the grown-in networks and the effect of impurity segregations. R.T.K.

N64-17449 Notre Dame U., Indiana

A PROJECTION DIODE TECHNIQUE FOR THERMIONIC EMISSION FROM SINGLE CRYSTALS OF REFRACTORY METALS Scientific Report No. 1

F. Gardner, F. Girouard, R. Anthony, and E. Coomes 8 Jan. 1964 46 p refs
(Contract AF 19(604)-8434)
(AFCRL-64-234; AD-431332)

An improved electron projection diode with an aluminum-backed fluorescent screen has been developed to study thermionic emission from single-crystal refractory metal filaments as a function of equilibration. Average thermionic constants ϕ_R and A_R may be obtained with the tube operating as a diode; point-by-point thermionic parameters may be obtained by photometric measurements. A modification of the projection diode allows the measurement of the elastically scattered primaries and high-energy secondary electrons in a separate tube. Data for recrystallized molybdenum are given. These indicate: (1) High work function is always associated with a terraced plateau, which develops on annealing. (2) The deviation of A_R from 120 for Mo may be accounted for by patch effect, without recourse to a significant temperature coefficient of work function. Author

N64-17476 Harshaw Chemical Co., Cleveland, Ohio

INVESTIGATION OF THIN FILM CADMIUM SULFIDE SOLAR CELLS Quarterly Technical Progress Report No. 1, 25 Nov. 1963-25 Feb. 1964

J. C. Schaefer, R. J. Humrick, and R. F. Belt 6 Mar. 1964 55 p refs
(Contract AF 33(615)-1248)
(AD-432192)

Higher efficiency cells appear probable when the barrier is formed chemically. Cells have been fabricated for exposure to "gamma" radiation. New contacting techniques are being investigated for application on the 1 ft^2 and 1/2 ft^2 arrays. The principal vacuum evaporation parameters of substrate temperature and surface perfection have been studied for CdS depositions. Thin films of CdS were prepared on Mo, Ta, Ti, Invar 36, quartz, Si, and CaF_2. Substrate temperatures ranged from 200° to 650° C. Optical studies have been performed on single crystals of CdS containing barrier layers. Different techniques of barrier application lead to characteristic optical constants of the surface layers. The efficiency decay of the photovoltaic cell in humid atmosphere can be retarded by SiO coatings. Preliminary results are encouraging for thin layers. Mathematical models describing photovoltaic cell behavior have been considered. Limited success has been achieved in explaining the short circuit current as a function of light intensity. Author

N64-17511 New York U., N.Y. Radiation and Solid State Lab.

RESEARCH DIRECTED TOWARD THE STUDY OF PHOTOVOLTAIC EFFECTS IN ORGANIC AND INORGANIC CRYSTALS AND THIN FILMS Final Report

H. Kallmann Sep. 1963 102 p refs
(Contract AF 19(604)-5495)
(AFCRL-63-432; AD-431887)

The conditions necessary for the production of various types of photovoltages are described, and the theory of these photovoltages is given for the various conditions. The relationship between photovoltages and rectification is discussed. The following special photovoltaic effects were investigated: photovoltaic effects in organic crystals (anthracene) with liquid and metal electrodes when the photoconductive material is excited, and photovoltages in organic crystals (anthracene) produced with special iodine electrodes when these electrodes are excited by light. Photovoltages of single crystals of cadmium sulfide were investigated with the following types of electrodes: insulating layers, metal contacts, jelly electrodes plus various incorporated materials, and liquid electrodes. Also investigated were: (1) photovoltages of various zinc–cadmium sulfide–phosphor powders, using a transient method; and (2) photovoltages that occur when visible light falls on thin germanium layers that were evaporated on a high-resistance substrate at a small angle-of-incidence, so that the single germanium crystals subtend an angle with the substrate. I.v.L.

N64-17614 Aerospace Corp., El Segundo, Calif.
BRITTLE FRACTURE OF CERAMICS
E. Stofel and H. Conrad 21 Mar. 1964 54 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-382; TDR-269(4240-10)-7; AD-433207)

A review is given of the present state of our knowledge of the brittle fracture of ceramics. It includes discussions of the theoretical strength of solids, the Griffith theory, and the role of dislocations. Other topics covered are the effects of environment, stress distribution, microstructure, and Weibull's theory. Author

N64-17618 Naval Research Lab., Washington, D.C. Metallurgy Div.
CHARACTERIZING FRACTURES BY ELECTRON FRACTOGRAPHY. PART XII: ILLUSTRATED GLOSSARY, SECTION I: QUASI-CLEAVAGE [Interim Report]
C. D. Beachem, B. F. Brown, and A. J. Edwards Jun. 1963 23 p refs
(NRL-Memo-1432, Pt. 12; AD-416457)

This report is one of a series intended to illustrate and explain the terminology used in describing the features in high-magnification fractographs. Quasi-cleavage is one of several fracture modes possible in the mechanical rupturing of quenched and tempered (martensitic) steels. The high-magnification surface topography in this fracture mode resembles true cleavage in that the fracture facets are relatively flat with markings that often, though weakly, resemble river patterns in true crystallographic cleavage. In addition to the steps that produce these markings, there are also "tongues" (cleavage on secondary planes) that strongly resemble true cleavage. But in addition there are, in quasi-cleavage, ridges produced by plastic deformation and rupture of thin webs of metal between two growing submerged crack fronts; these markings do not resemble true cleavage. Author

N64-17620 Uppsala U. (Sweden) Quantum Chemistry Group for Research in Atomic, Molecular and Solid-State Theory
COMPUTATION OF THE COHESIVE ENERGY, THE LATTICE PARAMETER, AND THE COMPRESSIBILITY OF IONIC CRYSTALS BY USING RADIALLY DEFORMED ATOMIC ORBITALS. I. THEORY Scientific Report No. 2
Kauko Mansikka 1 Sep. 1963 24 p refs
(Contract AF 61(052)-701)
(SR-2; ARL-64-47; AD-432550; Preprint 107)

The expression for cohesive energy of ionic crystals in the Heitler–London approximation has been derived from radially deformed atomic orbitals. The orbitals have been obtained by scaling the radial parts of the wave functions belonging to the corresponding free ions. For small values of the parameter σ ($\sigma = 1 - \eta$, η = scale factor) the wave functions can be expanded into the power series with respect to σ. Consequently, the cohesive energy can be expressed as a power series in a similar way, in which the first term represents the cohesive energy of the free ion approximation. The energy relations are aslo studied when the uniform partial scaling and uniform overall scaling are coupled. The results obtained are most useful for numerical applications, where the self-consistent field functions are employed in the numerical form. Author

N64-17661 Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
RESEARCH ON SEMICONDUCTOR TRANSPORT Final Report [1 Jun. 1959-31 Jan. 1964]
Reinhard K. Gereth Feb. 1964 126 p refs
(Contract Nonr-2934(00); ARPA Order-477)
(AD-432700)

Transmitted phonon drag is used to study different scattering phenomena in silicon. The mean free path L_ϕ of the relevant thermal phonons is measured at 4.2° K in diffused npn silicon structures. At this temperature L_ϕ is found to be 5,000μ ±1,000μ. A comparison is made between values of L_ϕ obtained from crucible grown and epitaxial silicon. Both crystal materials with equivalent doping levels yield the same L_ϕ at 77° K. L_ϕ due to phonon–phonon scattering at 77° K is 80μ ±10μ in p type epitaxial silicon. The transmitted phonon drag is proposed as a tool to study acoustic amplification of relevant thermal phonons in silicon at 77° K. These phonons have a frequency of 10^{12} cps. It is shown that such high-frequency phonons can interact very strongly with charge carriers via the deformation type coupling present in silicon. The fabrication of diffused 5-layer npn–pn silicon structures suitable for the amplification experiments is described. Author

N64-17706 California U., Berkeley. Lawrence Radiation Lab.
EFFECT OF POLYSLIP ON STRAIN-HARDENING IN ALUMINUM SINGLE CRYSTALS
J. D. Mote (Ph.D. Thesis) 14 Feb. 1964 34 p
(Contract W-7405-ENG-48)
(UCRL-11160) OTS: $0.75

Investigations were carried out on the effect of polyslip on strain hardening in fcc single crystals. It is shown that the rate of strain hardening increases for those orientations in which attractive dislocation intersections occur, and that those orientations that produce the greater number of such intersections exhibit the greater strain hardening. It is found that the barrier reactions considered by Hirth are not responsible for any strengthening. Special experiments on specimens with a [$\bar{1}$11] tensile axis revealed that the preexponential coefficient of the intersection equation is not constant as was previously assumed, but varies by several orders of magnitude. Furthermore, at temperatures above the critical temperature, the deformation mechanism is thermally activated. Author

N64-17708 California U., Berkeley. Lawrence Radiation Lab.
EFFECT OF HIGH PRESSURE ON THE ELECTRICAL RESISTANCE OF Bi, Yb, AND Dy

Philip Clark Souers (Ph.D. Thesis) 24 Jan. 1964 82 p refs
(Contract W-7405-ENG-48)
(UCRL-11220) OTS: $2.00

The experimental procedure of measuring the electrical resistance of bismuth, ytterbium, and dysprosium is discussed in detail. Above approximately 150° K, the temperature coefficient of resistance of bismuth is positive. Below 150° K in the region of 15 to 35 kbars, the coefficient becomes negative. The phase line for the large peak in the resistance-pressure isotherms of ytterbium was determined from 77° to 633° K. In the region 20 to 45 kbars, ytterbium shows a negative temperature coefficient of resistance. Dysprosium was examined at 20° C and in the region 77° to 200° K. C.L.W.

N64-17808 Ohio State U. Research Foundation, Columbus
AN INVESTIGATION OF INTERDIFFUSION IN METALLIC SINGLE CRYSTALS [Report for 15 Nov. 1963-15 Feb. 1964]
F. Fraikor, Y. Liu, G. W. Powell, J. P. Hirth, and V. Ruth Wright-Patterson AFB, Ohio, AF Mater. Lab., Feb. 1964 4 p
(Contract AF 33(657)-9996)
(AD-433509)

Research on the following is discussed: (1) seeking out and correcting the cause of the anomalous behavior of gold single crystals in the dilatometer; (2) growth of crystals for diffusion studies, and construction of apparatus for cutting and polishing these crystals; and (3) construction and testing of apparatus for the preparation of thin films from the diffusion couples. Author

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-16971 General Electric Co., Philadelphia, Pa.
PROPELLANT STORABILITY IN SPACE Second Quarterly Report, 1 Oct. 1963-31 Jan. 1964
W. Benton et al Edwards AFB, Calif., Rocket Propulsion Lab., Feb. 1964 83 p
(Contract AF 04(611)-9078)
(RPL-TDR-64-22; AD-431823)

Presented are the details of the preparation for the first series of tests in the Space Environmental Simulator. Results of the first test are given, and an analysis of these results are presented. The first test has indicated that earth storable propellant-tank temperatures may be suitably controlled by means of selected coatings. In addition, any short-term heat fluxes will be damped out in the propellant tank. Tests with cryogenic propellants were conducted and indicate the need for a longer data taking period in the second test. Author

N64-16984 North American Aviation, Inc., Los Angeles, Calif. Energy Conversion and Rocketdyne Div.
SPECTRAL EMISSIVITY OF FLASH COMBUSTION REACTION STUDY PROGRAM Semi-Annual Technical Summary Report, 1 Jun.-31 Dec. 1963
J. M. Gerhauser 5 Feb. 1964 53 p refs
(Contract Nonr-4236(00); Proj. Defender)
(NA-64-105; AD-431927)

Major achievements of the period have been: (1) disclosure of several chemical reactions that have theoretical flame temperatures greater than 5,000° K; (2) achievement of a brightness temperature of 5,800° K with a zirconium–potassium perchlorate mixture: (3) discovery of strong line emission in metal–potassium perchlorate reactions; (4) discovery of a very strong time dependency of line emission brightness during the progress of the reaction; (5) theoretical prediction of intense nonequilibrium light emission from doped metal-oxidizer reactions; and (6) experimental verification of the predicted possibility of achieving intense line emission from a metal-oxidizer reaction by doping with metal salts. Author

N64-17116 Automation Industries, Inc., Danbury, Conn. Sperry Products Div.
FEASIBILITY STUDY TO DETERMINE WHETHER ULTRASONIC TECHNIQUES CAN BE USED TO MEASURE MECHANICAL PROPERTIES OF CAST POLYURETHANES INTENDED FOR APPLICATION AS SOLID PROPELLANT BINDERS [Final Report] 15 Mar. 1960-15 Apr. 1962
A. M. Murdoch and H. E. Van Valkenburg Wright-Patterson AFB, Ohio, Aeron. Systems Div., Jul. 1963 38 p refs
(Contract AF 33(616)-7069)
(ASD-TDR-62-886; AD-415828)

Several series of specimens simulating both binder and propellant materials in various conditions of aging were studied. Ultrasonic examination of these specimen materials was performed, with the objective of finding ultrasonic properties that would indicate their physical condition. Results of tests indicate a significant dependence of both shear wave attenuation and relative acoustic impedance of certain specimen materials on their condition of aging. Author

N64-17152* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
AN EXPERIMENTAL INVESTIGATION OF CHEMICAL REACTION BETWEEN PROPELLANT TANK MATERIAL AND ROCKET FUELS OR OXIDIZERS WHEN IMPACTED BY SMALL HIGH-VELOCITY PROJECTILES
Robert P. Dengler Washington, NASA, Aug. 1963 39 p refs
(NASA TN D-1882) OTS: $1.00

High-velocity projectile penetrations of simulated propellant tanks were made to determine the impact sensitivity of tank materials in contact with liquid and solid rocket propellants. Tank materials investigated were aluminum, stainless steel, two titanium alloys, and three reinforced plastics. The propellants included the liquids oxygen, hydrazine, unsymmetrical dimethylhydrazine, and nitrogen tetroxide, and the solids Arcite 373 and Hercules CLW. Projectile penetration of titanium specimens acting as a wall of a tank containing liquid oxygen caused a chemical reaction between the tank wall and the contained propellant regardless of the material used for the impacting projectile. Violent reactions were initiated by penetrations having kinetic energies as low as 10.4 foot-pounds. Once a reaction was initiated, it propagated vigorously until one of the reactants was consumed. A complete penetration of the titanium tank wall was necessary for a reaction to occur. All other penetrations of tank materials in contact with the various propellants resulted in no reaction of the tank wall and the contained propellant. Author

N64-17156* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SPONTANEOUS REIGNITION OF PREVIOUSLY EXTINGUISHED SOLID PROPELLANTS
Carl C. Ciepluch Washington, NASA, Mar. 1964 16 p refs
(NASA TN D-2167) OTS: $0.50

The spontaneous reignition phenomenon associated with the extinction of solid propellants by sudden depressurization was investigated experimentally. The results indicated that many solid-propellant compositions may be susceptible to the

reignition phenomenon; however, the occurrence is a function of the operating conditions. All propellant compositions exhibited a minimum ambient pressure limit below which reignition was not obtained. Decreasing the characteristic time for the expansion, defined as the time required for the pressure to reach 50 percent of its initial value, suppressed the tendency for reignition to occur. Author

N64-17285 Atlantic Research Corp., Alexandria, Va. Kinetics and Combustion Div.
TECHNIQUES FOR THE STUDY OF COMBUSTION OF BERYLLIUM AND ALUMINUM PARTICLES
A. Macek, R. Friedman, and J. M. Semple Charlottesville Va. U., Feb. 1964 23 p refs Presented at the AIAA Conf. on Heterogeneous Combustion, Palm Beach, Fla., Dec. 1963
(Contract Nonr-3623(00); Proj. Squid)
(ARC-8-P; AD-431872)

Minimum igntion temperatures for single beryllium particles, under total pressures of up to 50 atmospheres, range from 2,380° to 2,650° K, depending on the partial pressure of oxygen in the ambient gas. Atmospheric pressure photographic studies of fine details of aluminum combustion have been made and are discussed qualitatively. The work described herein deals with a fundamental investigation of ignition and combustion of single metal particles of diameters ranging from 30 to 45 microns. Metal particles of known sizes and shapes are suddenly plunged into hot gases of known physical and chemical characteristics, and their behavior is observed. Author

N64-17375 Naval Ordnance Lab., White Oak, Md.
CALIBRATION FOR THE GAP TEST WITH A PENTOLITE DONOR
I. Jaffe, G. Roberson, and J. Toscano 29 Jan. 1963 21 p refs
(NOLTR-63-19; supersedes NOLTR-62-78; AD-401686)

A second calibration of the gap test was made with a pentolite donor replacing the tetryl donor of the standardized test. The calibration consisted of measuring the attenuation of the shock velocity in a Plexiglas rod, and calculating the corresponding shock pressure as a function of gap distance. Author

N64-17437 Naval Ordnance Lab., White Oak, Md.
THE CRITICAL CONDITIONS IN THERMAL EXPLOSION THEORY WITH REACTANT CONSUMPTION
J. Adler (Imperial Coll. of Sci. and Tech., London) and Julius W. Enig 31 Dec. 1963 24 p refs
(NOLTR-63-251; AD-432348) OTS: $2.60

The energy and chemical kinetic equations describing the behavior of a symmetrically heated reactive material with finite heat of reaction have been analyzed. For first order reactions the relationship between the parameters at criticality, and the critical induction period as a function of the parameters are determined. It is shown how the general *n*th order chemical reaction may be dealt with. The analysis results in an exact ignition temperature and a lower bound to the adiabatic temperature rise at criticality, which increase with the order of the reaction. Author

N64-17534* United Technology Corp., Sunnyvale, Calif.
THEORY OF IGNITION AND IGNITION PROPAGATION OF SOLID PROPELLANTS IN A FLOW ENVIRONMENT
R. S. Brown, T. K. Wirrick, and R. Anderson N.Y., Am. Inst. of Aeron. and Astronautics [1964] 12 p refs Presented at the AIAA Solid Propellant Rocket Conf., Palo Alto, Calif., 29–31 Jan. 1964
(NASA Contract NAS7-156)
(AIAA Paper-64-157) AIAA: $0.50 members, $1.00 nonmembers

Ignition and subsequent ignition propagation on the surface of a solid propellant in a flow environment have been subjected to a detailed theoretical analysis that has as its basis the recently developed heterogeneous ignition theory. The general theoretical model of ignition and ignition propagation is described by the two-dimensional unsteady-state heat-conduction equation with a variable rate of external heat transfer to the exposed surface of the propellant. Heat transfer by convection, radiation, hypergolic heating, and conduction of heat along the longitudinal axis of the propellant surface parallel to the gas flow is considered. The solution of the resulting equations describes the temperature history of the propellant surface and flowing gases as a function of longitudinal position. Verification of the theoretical model is demonstrated by comparison with experimental data. Author

N64-17598* Warner and Swasey Co., Flushing, N.Y. Control Instrument Div.
ANALYSIS OF HIGH TEMPERATURE GASES IN SITU BY MEANS OF INFRARED BAND MODELS
Gunter J. Penzias and G. Jordan Maclay 15 Dec. 1963 45 p refs
(NASA Contract NAS3-1542, Phase III)
(NASA CR-54002; W&S-TR-28) OTS: $4.60 ph, $1.55 mf

In order to develop techniques of combustion gas analysis in situ for propulsion research applications, the dependence of infrared absorptance upon partial pressure was investigated for CO_2 and H_2O. The random band model was used to establish quantitative relationships for use in gas analysis. The necessary band model parameters were measured in furnace-heated gases, in flat flames on porous burners, and in shock-heated gases. The variation of these parameters with temperature was measured from 600° to 2,400° K. Explicit procedures were developed to set up calibration formulas for gas analysis in situ and to determine the parameters needed for applications. Author

N64-17645 Ethyl Corp., Baton Rouge, La.
RESEARCH ON LIGHT METAL FUELS AND OXIDIZER CHEMISTRY. PART II– OXIDIZER CHEMISTRY Quarterly Progress Report No. 3, Nov. 1963–Jan. 1964
W. E. Becker, D. H. Campbell, and W. B. Kirsch [1964] 12 p refs
(Contract AF 04(611)-9376)
(EC-599; AD-432891)

Investigation of the chemistry of inorganic NF_2 compounds is proceeding along the following lines: (1) The behavior of HNF_2 in possible ionizing solvents is being observed. The conductivity of a trifluoroacetic acid solution of HNF_2 (1 millimole HNF_2 in 12 ml acid) was about an order of magnitude greater than that of the pure solvent. (2) The electrical conductivity of $ClNF_2$ dissolved in several different nonaqueous solvents has been investigated. Methanol, acetonitrite, and N-methylacetamide have been used as solvents. (3) A kinetic investigation of the reaction of difluoramine with deuterium oxide has been initiated to further elucidate the behavior of difluoramine in ionizing solvents. The exchange reaction can be readily followed by NMR at low (–44° C) temperatures. (4) Further experimentation with tetramethylammonium amalgam is in progress. Author

N64-17650 Stauffer Chemical Co., Richmond, Calif.
HIGH ENERGY OXIDIZERS Annual Technical Summary Report, 1 Feb. 1963-31 Jan. 1964
K. O. Christe, A. E. Pavlath, and E. G. Wallace [1964] 16 p refs
(Contract Nonr-4019(00); ARPA Order 399-62)
(AD-432343)

The study consisted of the preparation and structure determination of chlorinetrifluoride complexes with strong Lewis acids such as BF_3, PF_5, AsF_5 and SbF_5. A thorough investigation proved overwhelmingly the ionic structure of these compounds with a general formula of $ClF_2^+X^-$ where X^- is BF_4^-, PF_6^-, AsF_6^-, or SbF_6^- Author

N64-17683* Bureau of Mines, Pittsburgh, Pa. Explosives Research Center
AUTOIGNITION OF DOWTHERM A IN AIR AT ELEVATED PRESSURES Final Report, Jun. 3-Nov. 30, 1963
M. G. Zabetakis, A. L. Furno, R. E. Kennedy [1963] 10 p refs
(NASA Appropriation 80X0107)
(NASA CR-55932; Rept. 3905) OTS: $1.10 ph, $0.80 mf

The data presented give the operating range of interest and the vapor pressure of Dowtherm A between 460° and 750° F. The data indicate that autoignition of Dowtherm A should not occur in the normal operating range. However, an increase in the working temperature maximum at the specified pressure maximum (600 psia) should be considered hazardous; conversely, an increase in the working pressure at the specified temperature maximum (680° F) should also be considered hazardous with Dowtherm A. An increase in one variable (temperature or pressure) should be offset by a decrease in the other variable to prevent overlap of the operating range and the autoignition region. Author

N64-17751* National Aeronautics and Space Administration, Washington, D.C.
FORMATION OF DETONATION WAVES IN HYDROGEN-OXYGEN MIXTURES FROM 0.2 TO 2 ATMOSPHERES INITIAL PRESSURE IN A 54-METER LONG TUBE
Loren E. Bollinger (Ohio State U.) Apr. 1964 41 p refs
(NASA Grant NsG-44-60)
(NASA TN D-2256) OTS: $1.00

Experimentally it was found that the flame propagation rate of mixtures containing different fuel concentrations was retarded near the end of the closed detonation tube, but remained essentially constant when the end was open to the atmosphere. A tentative explanation is that the shock wave, separated by an appreciable distance from the combustion wave of the detonation wave, reflects from the closed end of the tube and retards the oncoming combustion wave. Author

N64-17783 Shell Development Co., Emeryville, Calif.
FUNDAMENTAL RESEARCH ON ADVANCED OXIDIZERS Final Report, Dec. 1962-Dec. 1963
D. W. Barnum, R. M. Curtis, F. S. Mortimer, and J. N. Wilson [1964] 108 p refs
(Contract DA-31-124-ARO(D)-54; ARPA Order-402)
(S-13907; AD-432862)

Research on advanced oxidizers covered the following: (1) thermochemical data—heats of formation, ionization potentials; electron affinities, and additivity and constancy of bond energies; (2) extended Huckel calculation—computer programs and results; (3) intramolecular interactions between nonbonded atoms—potential energy functions, anisotropy of nonbonded interactions, correction for ionic character, force constants for nonbonded repulsions, nonbonded repulsion energies from overlap integrals, interaction between atoms and lone-pair electrons, use of valence-bond theory to estimate nonbonded repulsion; and (4) repulsive energy in the alkali halides—definitions, formulas, and experimental data. E.K.R.

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-17311 Lockheed Aircraft Corp., Burbank, Calif.
INLET-EXHAUST-THRUST REVERSER PROGRAM FOR THE COMMERCIAL SUPERSONIC TRANSPORT Second Quarterly Progress Report
10 Jan. 1964 61 p
(Contract AF 33(657)-11419)
(LR-17283-1; AD-431161) OTS: $6.60

Activities are reported as follows: (1) Transfer functions were derived for inlets "A" (axially symmetric mixed compression) and "B" (two-dimensional mixed compression). (2) Inlet "A" was found to have poor off-design characteristics, and an effort was initiated to improve the configuration of the inlet. (3) The inlet "B" computer model was developed. (4) A stability analysis for the combined engine-inlet system for inlet "B" and both the GE4/J3F and the GE4/F3A engines was undertaken for various disturbances and failures. (5) A dynamic study of the engine-inlet airplane system was initiated. (6) The development of an axially symmetric external compression inlet with an isentropic spike was begun. (7) A pretest report, summarizing the test program to be carried out in a wind tunnel, was written. R.T.K.

N64-17820* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
AN EXPERIMENTAL INVESTIGATION OF UNCOOLED THRUST CHAMBER MATERIALS FOR USE IN STORABLE LIQUID PROPELLANT ROCKET ENGINES
R. W. Rowley 15 Feb. 1964 30 p refs
(NASA Contract NAS7-100)
(NASA CR-53367; JPL-TR-32-561) OTS: $2.60 ph, $1.10 mf

An experimental investigation of the comparative merits of various uncooled thrust chamber materials was conducted by performing engine tests in which N_2O_4/N_2H_4 propellants were used at a nominal mixture ratio of 1.0. The chamber pressure was 150 psia and the nominal sea-level thrust was 85 lb. Erosion of graphites, ablative plastics, and refractory metals was found to be a function of the local thermal and chemical environments existing at the thrust chamber wall. The role of a particular impinging-stream injector influencing local conditions at the wall was determined by (1) evaluating the properties of the spray produced by nonreacting liquids and (2) measuring local heat-transfer rates to the chamber wall in the operating rocket engine by means of embedded thermocouples and a transient conduction analysis. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-16961 American Meteorological Society, Boston, Mass.
INVESTIGATION OF THE PHYSICAL CONDITIONS IN SOLAR PROTUBERANCES BY THE EMISSION LINES WITH SELF-ABSORPTION [ISSLEDOVANIE FIZICHESKIKH USLOVII V SOLNECHNYKH PROTUBERANTSAKH PO EMISSIONNYM LINIIAM S SAMOPOGLOSHCHENIEM]
A. B. Severnyi Bedford, Mass., AF Cambridge Res. Labs., Mar. 1956 23 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), no. 12, 1954, p 33–45
(Contract AF 19(604)-6113)
(T-R-84; AD-430611)

Examined is the problem of determining the physical conditions in protuberances on the basis of study of extra-ecliptic spectrograms of emission lines burdened with self-absorption (e.g., lines H_α, H, and K, and others). Application of the proposed method to the typical bright protuberance of 19 July 1952 made it possible to find the number of Ca^+ ions in the ground state, the number of hydrogen atoms in the second quantum state, the number of orthohelium atoms in the 2s state, the electron density, and also to evaluate the state of ionization. The kinetic temperature of the protuberance, found from the contours of lines H_α, H, and K proved to be ~ 14,000° F. The possibility of the formation of a high electron temperature during the motions of protuberances is investigated. Author

N64-17110 Argonne National Lab., Ill.
MEASUREMENT OF THE COSMIC-RAY NEUTRON BACKGROUND
Jacob Kastner, B. G. Oltman, and L. D. Marinelli *In its* Radiological Phys. Div. Summary Rept., Jul. 1962–Jun. 1963 Dec. 1963 p 34–54 refs (See N64-17107 09-23) OTS: $3.00

Twin liquid scintillators, xylene and hexafluorobenzene, were used in the measurement of the cosmic-ray neutron background. The twin system proved to be an excellent system for fast neutron spectroscopy when the ratio of neutrons to gammas is not too small (> 1%). However, the tool proved to be disappointing for background studies because of the relatively large errors produced by internal radioactive contamination of the system. Also, two pulse-shape discrimination circuits, for discriminating between neutron and gamma-ray produced scintillations, are discussed. Both circuits utilize an RCA type 6810A 14-stage PM tube. In one type of circuit, the discrimination pulses, which gate the pulse height analyzer (PHA) to admit neutron events, are taken from the last dynode of the photomultiplier. Under the proper conditions of operation, proton-recoil scintillations will produce positive pulses at the dynode, which will gate the TMC pulse-height analyzer. In the second type of circuit, the discriminations, which gate the PHA for the analysis of neutrons events, are formed by adding negative pulses from the PM anode to the corresponding positive pulses from the 13th dynode. Since proton-recoil scintillations contain a relatively larger portion of slow components than those due to electrons, they will produce positive resultant pulses that will gate the PHA. I.v.L.

N64-17810* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE RADIATIONS: A COMPILATION AND DISCUSSION
W. T. Roberts 21 Jan. 1964 24 p refs
(NASA TM X-54700; MTP-AERO-64-4) OTS: $2.60 ph, $0.92 mf

The natural radiations encountered during a space mission will fall into one of five categories. There will be Van Allen belts, galactic cosmic radiations, solar winds, solar flares, and photon radiations. Each type of radiation is examined from the point of view of the Apollo program and the associated lunar logistics vehicle, but with some comments pointing to extended missions in space, to determine the importance that should be assigned to each class. Author

N64-17676* General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
A STUDY OF SPACE RADIATION SHIELDING PROBLEMS FOR MANNED VEHICLES
R. K. Wilson, R. A. Miller, and R. L. Kloster 8 Jun. 1962 192 p refs
(NASA Contract NAS5-1093)
(NASA CR-56005; FZK-144) OTS: $13.50 ph, $5.96 mf

The resolution of the problem of protecting space vehicle crews from charged particles of either solar-flare or trapped-radiation origin will probably depend upon some sort of shielding. The basic problem is concerned with determining quantitatively the attenuation requirement of the incident radiation and selecting an appropriate material to provide this shielding. The discussion given includes the hazards of space radiation, the methods of dose calculation, the development of a proton penetration procedure, a summary of cross-section data, and the results of shielding calculations, with particular emphasis on contributions to the dose from secondary radiation. Author

N64-17731* RAND Corp., Santa Monica, Calif.
NOTE ON LOW-LEVEL GEOMAGNETIC RING-CURRENT EFFECTS
E. H. Vestine Jun. 1963 33 p refs
(NASA Contract NASr-21(05))
(NASA CR-56010; RM-3674-NASA) OTS: $3.60 ph, $1.19 mf

Various measurements of the intensity of radiation within the inner Van Allen belt have indicated little possibility that the equatorial magnetic field of the belt should exceed one-half gamma. The 12-yr means of geomagnetic disturbance data show an equatorial latitude variation, which could arise from a transient equatorial ring current at a height within the outer reaches of the inner belt. This small transient equatorial ring current may be introduced to suitable equatorial heights by downward expansion of a higher ring current present during magnetic storms. This possibility would be susceptible to experimental check. Another possibility is increased westward current flow within the equatorial ionosphere, or enhanced compression of the equatorial magnetosphere during storm days. Author

N64-17817* Minnesota U., Minneapolis Cosmic Ray Group
SHOCK WAVES IN INTERPLANETARY PLASMA
Paul J. Kellogg Feb. 1964 14 p refs Presented at the Intern. Conf. on Cosmic Rays, Jaipur, Dec. 1963
(NASA Grant NsG-281-62)
(NASA CR-53364; CR-69) OTS: $1.60 ph, $0.80 mf

The following are discussed: (1) the structure of the shock wave around the earth, as postulated by Axford and by Kellogg; and (2) the front of an approaching solar-plasma cloud (with the aim of improving the predictions of Parker's shock-wave theory in regard to Forbush decreases). R.T.K.

N64-17828 National Aeronautics and Space Administration, Washington, D.C.
THE EDGE OF THE POLAR PLATEAU FOR GALACTIC COSMIC RAYS AND THEIR CHARGED ALBEDO
J. A. Van Allen and W. C. Lin (Iowa State U.) Apr. 1964 13 p refs
(NASA TN D-2248) OTS: $0.50

The Explorer 7 value of the magnetic shell parameter L = 2.9 to represent the edge of both northern and southern polar plateau is confirmed and shown to be applicable to the complete range of longitude in both hemispheres. A further example of the validity of L as a latitude parameter for particles arriving from infinity has been exhibited, and the position of the edges of the plateau in September 1961 did not differ significantly from the average position during the period October 1959 to February 1961. Author

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-17226* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

DETERMINATION OF TRACKING STATION LOCATIONS BY DOPPLER AND RANGE MEASUREMENTS TO AN EARTH SATELLITE

D. L. Cain and T. W. Hamilton 1 Feb. 1964 21 p refs
(NASA Contract NAS7-100)
(NASA CR-53196; JPL-TR-32-534) OTS: $2.60 ph, $0.83 mf

The accuracy to which the station coordinates may be obtained from the tracking of single and multiple passes by means of range or Doppler (range-rate) measurements alone is examined under the assumption that the satellite's orbit is perfectly known. The results indicate that dramatic improvement is attained when data from two different passes are statistically combined. A method is introduced whereby this improvement may be easily understood. The middle semiaxis of the three-dimensional error ellipsoid associated with a single pass is introduced as the most valuable measure of accuracy. The variation of accuracy with satellite altitude, station latitude, data type, and the geometry of the pass is extensively examined. The ranging accuracy equivalent to a 0.03-m/sec range-rate accuracy varies from 1.8 m at a satellite altitude of 100 nm to 15.5 m at 1000 nm, and such data accuracies should permit determination of all three station coordinates to about 5 m when the data from two or more passes are utilized. Author

N64-17442 Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.

DIFFERENTIAL FIRING CORRECTIONS AND ACCURACY FORMULAE

N. W. Albright Feb. 1964 31 p
(Contract AF 04(695)-269)
(BSD-TDR-63-216; TDR-269(4922)-1; AD-431843)

An object on a Keplerian ballistic trajectory outside the earth's atmosphere travelling toward a nominal target is considered. Discussed are the differential velocity correction that must be applied to this object to hit a target differentially displaced in time and space from the nominal one, and the errors at the displaced target that are produced by errors in the various firing parameters. Author

N64-17473 Air Force Special Weapons Center, Kirtland AFB, N. Mex.

DISPERSION AND PROBABILITY ANALYSES FOR SPACE VEHICLES

Harvison Hunt Jan. 1964 85 p refs
(AFSWC-TDR-63-66; AD-429936)

This report presents methods of assessing effects of parameter variance on missile trajectories. Included are the derivation of 3 sigma dispersion areas, failure modes and the probability of occurrence, and probabilities of land impact with associated hazards to human life. Author

N64-17487 Brown Engineering Co., Inc., Huntsville, Ala. Space and Defense Systems Labs.

A FORTRAN PROGRAM TO CALCULATE A BALLISTIC MISSILE TRAJECTORY FROM LAUNCH OR ANY POINT THEREAFTER TO IMPACT

W. B. Warren Dec. 1963 35 p refs
(Contract DA-01-009-AMC-75(Z))
(Tech. Note R-84; AD-432285)

This program computes a two-dimensional, point mass ballistic trajectory from any point, either during burning or after burnout, to any point thereafter to impact. The program takes into account air resistance and the variation of the gravitational field with altitude. It uses a system of coordinates (X and Y) with the origin at the starting point of the trajectory. The program is written in FORTRAN IV for the IBM 7040 computer. Author

N64-17549 Technische Hochschule Stuttgart (W. Germany)

CONTRIBUTION TO THE INVESTIGATION OF THE ROTATIONS OF FIXED SATELLITES ON CIRCULAR ROTATION PATHS [BEITRAGE ZUR UNTERSUCHUNG DER DREHBEWEGUNGEN STARRER SATELLITEN AUF KREISFORMIGEN UMLAUFBAHNEN]

K. Magnus [1963] 25 p refs Presented at the Ann. Meeting of the Wiss. Ges. Fur Luft- und Raumfahrt [Munich, 8–12 Oct. 1963] In GERMAN; ENGLISH summary

The equations of motion for rigid satellites in a radial gravity field are transformed for the case of small-size satellites. A special solution of these equations is used as a starting point to examine the stability of different spatial orientations of satellites of various shapes. Stability diagrams are given for the following three cases: satellites with spin about an axis of symmetry perpendicular to the plane of the orbit; satellites with an orientation of the three principal axes, invariable with respect to the earth; satellites without spin. Some general results are given concerning the relations between the principal moments of inertia, and concerning the spin and the stability of different orientations of the satellite. Author

N64-17557* Bellcomm, Inc., Washington, D.C.

DYNAMICS ANALYSIS OF A TWO-BODY GRAVITATIONALLY ORIENTED SATELLITE

H. J. Fletcher, L. Rongved, and E. Y. Yu (Bell Telephone Labs.) Repr. from Bell System Tech. J., v. 42, no. 5, Sep. 1963 p 2239–2266 refs
(Sponsored by NASA)

The rigid body motion of a two-body satellite under the action of gravitational torques is analyzed. The satellite consists of two rigid bodies connected by a universal joint where damping is provided in the two journals. The motion of the satellite relative to the mass center thus has five degrees of freedom, two of which are provided with energy dissipation. It appears that the rigid body motion of such a composite satellite will automatically converge upon a motion in which a given axis of the satellite is earth-pointing. The equations of motion are derived directly from those of Euler. Necessary stability criteria are established. Numerical solutions for a practical scheme are presented. Author

N64-17593* Geophysics Corp. of America, Bedford, Mass.
A STUDY OF THE METEOROLOGY OF MARS AND VENUS Quarterly Progress Report No. 4, 6 Oct. 1963-5 Feb. 1964
[1964] 25 p refs
(NASA Contract NASw-704)
(NASA CR-53285) OTS: $2.60 ph, $0.95 mf

Computations of the radiative equilibrium distribution of temperature between the cloud-base and the surface of Venus were completed, and the results are presented. To the extent that this region of the Venus atmosphere is in radiative equilibrium, and to the extent that the computed temperature distribution is thermally stable, the results provide estimates of the actual temperature versus altitude distribution below the clouds. Work has continued on the construction of a model radiation budget for the planet Mars. A preliminary version of the average annual radiation budget at the top of the Martian atmosphere is presented. Author

N64-17631 Aerospace Corp. El Segundo, Calif. Systems Research and Planning Div.
THE EFFECT OF GEOPHYSICAL AND GEODETIC UNCERTAINTIES AT LAUNCH AREA ON BALLISTIC MISSILE IMPACT ACCURACY
R. G. Gore 22 Jan. 1964 62 p
(Contract AF 04(695)-269)
(BSD-TDR-63-256; TDR-269(4922)-2; AD-433163)

The effects of uncertainties in the geophysical and geodetic parameters related to the establishment of ballistic missile launch sites on the impact accuracy of the ballistic missile are derived analytically. Curves of the derived impact miss coefficients are presented for radio- and inertially-guided missiles for ranges of 500 to 21,000 nmi and burnout angles of 5° to 90° from the vertical. Author

N64-17680* Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
ASTRODYNAMICS OF LUNAR SATELLITES. PART II: LUNAR ORBIT STABILITY Final Report
G. Pinkham and F. Sobierajski Nov. 1963 62 p refs
(NASA Contract NAS8-5015)
(NASA CR-55973; RE-170) OTS: $6.60 ph, $2.06 mf

The purpose of this part of the contract was to study the stability of lunar satellites perturbed by the moon's triaxial potential and by the attractions of the earth, sun, and planets. An approximate analytic solution for the motion of a lunar satellite was derived, and extensive numerical studies were performed. This report contains the conclusions and data from these studies. Author

N64-17721* National Aeronautics and Space Administration, Washington, D.C.
INITIAL CONCEPT OF LUNAR EXPLORATION SYSTEMS FOR APOLLO. VOLUME I: SUMMARY [Final Report]
Mar. 1964 176 p refs Prepared by Boeing Co.
(NASA Contract NASw-792)
(NASA CR-35) OTS: $3.00

Results are presented of an engineering study conducted to provide a conceptual design of a modular lunar-base system for Project Apollo lunar explorations. The system and subsystem functional analyses and conceptual designs accomplished in this study are summarized. Among the topics discussed are the physical environment, lunar-base system requirements, base-design integration, lunar-base construction concepts, lunar-base operations concepts, logistic-support concepts, typical lunar-base operations plans, and subsystem analysis and module configurations. R.T.K.

N64-17757 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
NON-UNIFORMLY-WEIGHTED ORTHONORMAL OVER-DAMPED EXPONENTIAL APPROXIMATIONS
J. M. Mendel 7 Jan. 1964 101 p refs
(SM-45777)

Weighting functions that emphasize small values of time, large values of time, or a range of time $[t_1, t_2]$, $t_1 > 0$, are considered. Exponential approximants are developed in terms of the classical Jacobi Polynomials. It is shown that these approximants (1) are orthonormal with respect to a nonuniform weighting function (the design of which is discussed); (2) are of any asymptotic order (in the s-domain); and (3) have their poles equally spaced along the negative-real axis of the s-plane. The design of these approximants from a priori approximation specifications is considered in detail. It is shown that the introduction of the nonuniform weight complicates the evaluation of the Fourier coefficients (spectrum). Procedures for resolving the complication are presented for the cases when the approximated function is known in either analytical form, analog form, or discrete form. Author

N64-17795* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIATIVE EQUILIBRIUM IN PLANETARY ATMOSPHERES: I. APPLICATION OF STRONG LINE ABSORPTION LAW TO THE ATMOSPHERE OF VENUS
R. A. Hanel and F. Bartko Jan. 1964 48 p refs
(NASA TM X-51525) OTS: $4.60 ph, $1.64 mf

The temperatures, the net fluxes, and the specific intensities were calculated for a CO_2–N_2 atmosphere in radiative equilibrium. The wavelength, temperature, and pressure dependence of the CO_2 absorption, including the excited bands, was considered. Solar radiation absorbed in the clear atmosphere influences the temperature profile distinctly. The effects of various CO_2 concentrations, cloud top pressure levels, and cloud reflectivities on the equilibrium temperatures are also discussed. Author

N64-17809 Autonetics, Anaheim, Calif.
ORBIT DETERMINATION USING KALMAN'S METHOD
Thomas L. Gunckel, II [1963] 49 p refs Paper presented at the ION Conv., 16 Apr. 1963
(Publ. 552-A-30)

Even though Kalman's techniques are based upon linear systems, they can be applied to orbit determination problems by assuming that the estimation error can be described by a linear expansion about the estimated trajectory. Such a linear expansion involves some loss of accuracy, but it considerably simplifies the computation problem. The important features of optimum estimation, as they relate to the orbit determination problem, are discussed. On the basis of this discussion a block diagram for the orbit determination system is presented. A brief derivation of the mechanizations equations and several examples of these equations are given to serve as the basis for a discussion on the computer requirements and the flexibility of the system. I.v.L.

N64-17810 Autonetics, Anaheim, Calif. Inertial Navigation Div.
EXACT FIRST-ORDER NAVIGATION-GUIDANCE MECHANIZATION AND ERROR PROPAGATION EQUATIONS FOR TWO-BODY REFERENCE ORBITS
K. C. Kochi 16 Jul. 1963 16 p refs
(Pub. 552-A-33)

A complete exact first-order solution to the two-body relative motion (linear perturbation) equations of motion is presented. This solution, which is called the transition matrix, is valid for all two-body conical orbits and constitutes the complete six-parameter solution to the error propagation for all two-body terminals. Also, an exact explicit first-order guidance law mechanization for impulsive controls, which is valid for all conical orbits, is given; linear guidance laws, which assume impulsive controls, are discussed. I.v.L.

N64-17818* Rensselaer Polytechnic Inst., Troy, N.Y.
CHEMISTRY OF THE ATMOSPHERE OF THE PLANET VENUS Technical Status Report No. 3, 1 Aug. 1963-31 Jan. 1964
P. Harteck, R. R. Reeves, Jr., and Barbara A. Thompson 1964 4 p
(NASA Grant NsG-261-62)
(NASA CR-53365) OTS: $1.10 ph, $0.80 mf

In an experiment designed to detect microwave emission from chemical reactions, signals of about 25 db were obtained for a discharge through SO_2, about 10 to 15 db for a discharge through CO_2, and 0.5 to 1 db through air or argon. Whether microwave emission also is generated by the chemical reactions alone (outside of a discharge tube) was not determined. Photochemical studies, using an iodine lamp, are outlined. R.T.K.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-16985 General Dynamics/Astronautics, San Diego, Calif.
WS 107A-1. BIBLIOGRAPHY OF RESEARCH AND DEVELOPMENT REPORTS FOR 1963
R. C. Spalding Feb. 1964 281 p refs
(GDA-ACW64-002; AD-430535)

This bibliography is arranged by report number and by subject. Among the categories included are: (1) aerodynamics; (2) flight-test reports; (3) project detail specifications; (4) operating and maintenance manuals; (5) installation and instruction manuals; (6) thermodynamics, heat transfer, anti-icing analysis, cabin pressurization; (7) electronics, radio, guidance, servomechanisms, instruments, instrumentation; (8) preliminary design reports, brochures, pictorial drawings; (9) progress reports, summaries, visits, investigations, status reports; (10) stress analysis, static and structure tests; and (11) weight and balance reports. I.v.L.

N64-17016* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FORCED-OSCILLATION METHOD FOR DYNAMIC-STABILITY TESTING
Robert A. Kolgore and Benjamin T. Averett *In* Am. Inst. of Aeron. and Astronautics AIAA Aerodyn. Testing Conf. [1964] p 59-62 ref (See N64-17013 09-01) AIAA: $5.00 members, $10.00 nonmembers

A small-amplitude, forced-oscillation technique is described. Particular emphasis is given to those features of a mechanically driven oscillation balance and the associated instrumentation that contribute to the accuracy and rapidity with which the important dynamic-stability parameters may be determined. Examples of data obtained by using the small-amplitude, forced-oscillation technique are given, along with indications of how the data may be used both in the development of acceptable configuration and in the accurate prediction of the free-flight motion of the body. R.T.K.

N64-17155* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRIAXIAL BALANCING TECHNIQUES (A STUDY OF SPACECRAFT BALANCE WITH RESPECT TO MULTIPLE AXES)
William E. Lang Washington, NASA, Mar. 1964 37 p refs
(NASA TN D-2144) OTS: $1.00

Spacecraft unbalance tolerance is likely to be expressed in terms of displacement of the center of gravity from its nominal position, and angular deviation between the principal and reference axes. This study discusses the relations that define the unbalance of a spacecraft, with respect to three mutually perpendicular reference axes, in terms of measurable mass parameters. It was motivated by the need to develop practical methods for balancing the San Marco spacecraft (the San Marco project is a joint effort of Italy and the United States). The theory proved directly and effectively applicable; but complications due to the inaccuracies of measured input data necessitated the development of modified methods for computing corrections. Author

N64-17159* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC LONGITUDINAL STABILITY CHARACTERISTICS OF THE TWO FINAL STAGES OF A FOUR-STAGE LAUNCH VEHICLE
Royce L. Mc Kinney Washington, NASA, Mar. 1964 21 p
(NASA TN D-2190) OTS: $0.50

Tests were conducted in the Langley Unitary Plan wind tunnel on the third and fourth stages of the spacecraft-orientation-control-system (SOCS) launch vehicle with a cone-cylinder nose. Two fin sizes and two shapes of a small fairing ring on the nose were tested at Mach numbers of 2.30, 2.96, 3.96, and 4.65 throughout an angle-of-attack range from approximately $-7°$ to $7°$ at an angle of sideslip of $0°$. The Reynolds number for the test was 2×10^6 per foot. The results of the investigation indicated regions of instability for the configuration with small fins. However, the configuration with large fins and both with and without the fairing rings provided a satisfactory margin of stability throughout the Mach number range of the investigation. Author

N64-17260 Sandia Corp., Albuquerque, N. Mex.
PRELIMINARY EVALUATION OF EARTH TARGETS FOR USE IN IMPACT EFFECTS STUDIES Development Report
Louis Jean Thompson (N. Mex. U.) and John L. Colp Mar. 1964 65 p refs
(SC-DR-316-63) OTS: $1.50

This report: (1) evaluates the fundamental mechanisms involved in soil impacts by cylindrical projectiles with velocities of 500 to 700 fps; (2) defines the problem of specifying impact targets that closely simulate various portions of the earth's surface; and (3) describes an analytical and experimental program intended to obtain the information needed to properly specify a simulated earth target for use in Aerospace Nuclear Safety impact tests. Author

N64-17357 Aerospace Corp., El Segundo, Calif. Systems Research and Planning Div.
A NEW METHOD OF ATTITUDE STABILIZATION
A. S. Gutman 23 Jan. 1964 69 p refs
(Contract AF 04(695)-269)
(SSD-TDR-63-358; TDR-269(4513-10)-2; AD-432841)

A new concept of attitude stabilization is presented. The basic purpose of stabilization to beam radiation into a definite direction is combined with the stabilization system by means of a stabilized reflector. A spin-stabilized satellite is magnetically or electrostatically suspended on a gravity-gradient stabilized reflector. The reflector serves to direct the radiation emanating axially from the spin-stabilized satellite toward the earth. This concept is demonstrated on a communications satellite and on a surveillance satellite in which the spin motion of the satellite is used to generate a continuous circular scan on the surface of the earth. The proposed system, in addition to the advantages of using high gain antennas and optical scanning systems, also has inherent dynamical advantages resulting in higher accuracies than passive systems and better reliabilities than in presently known active attitude control systems. Author

N64-17436 Lincoln Lab., Mass. Inst. of Tech., Lexington
SURFACE RADIATION FROM RE-ENTRY VEHICLES
John S. Strano 3 Sep. 1963 65 p refs
(Contract AF 19(628)-500)
(PA-38; AD-417926)

The surface radiation associated with reentry is considered. As a preliminary, the basic gas dynamic necessities are assembled and incorporated into a procedure for calculating the surface radiation. The geometrical effects of ablation are also included. Some numerical calculations are obtained, but these are for gray bodies only. Author

N64-17522 ARO, Inc., Arnold Air Force Station, Tenn.
TRANSONIC STATIC STABILITY TEST OF TWO 0.00333-SCALE MODELS OF THE SATURN V LOR CONFIGURATION
P. W. Martin and H. Kaupp, Jr. Arnold Eng. Develop. Center, Feb. 1964 23 p refs
(Contract AF 40(600)-1000)
(AEDC-TDR-64-40; AD-431230)

A wind-tunnel test was conducted to determine the transonic longitudinal static stability and drag characteristics of two 0.00333-scale models of the Saturn V Lunar Orbit Rendezvous (LOR) vehicle. Effects of reducing the conical frustum angle on the Lunar Excursion Module from 18°46′ to 8°35′ and on the second-to-third stage adapter from 17°42′ to 16°40′ were investigated. Fin and engine shroud effects on stability and drag were determined for one configuration. The model angle-of-attack was varied from −4° to +22°, and the Mach number was varied from 0.5 to 1.4. Decreasing the frustum angles reduced the forebody axial-force coefficient at Mach numbers above 0.90 but showed negligible influence on other aerodynamic force coefficients. Removal of fins and engine shrouds moved the neutral-point location forward approximately 3 body diameters at all Mach numbers investigated. Author

N64-17556* Bell Telephone Labs., Inc., Murray Hill, N.J.
A PASSIVE GRAVITATIONAL ATTITUDE CONTROL SYSTEM FOR SATELLITES
B. Paul, J. W. West, and E. Y. Yu Repr. from Bell System Tech. J., v. 42, no. 5, Sep. 1963 p 2195–2238 refs
(Sponsored by NASA)

It is shown how the gravity-gradient effect may be utilized to design a long-lived, earth-pointing satellite attitude-control system that requires no fuel supplies, attitude sensors, or active control equipment. This two-body system is provided with a magnetic hysteresis damper that effectively damps out oscillations (librations) about the local vertical. The long rods, which must be extended in space from coiled up metal tapes, provide the required large moments of inertia and possess adequate rigidity and sufficient strength to endure the rigors of the extension process. The system is compatible with the requirements of multiple satellite launchings from a single last-stage vehicle. Analysis indicates that the gravitational torques are sufficient to keep the disturbing effects of solar radiation pressure, residual magnetic dipole moments, orbit eccentricity, rod curvature, eddy currents, and meteorite impacts within tolerable limits. Author

N64-17675* Sperry Gyroscope Co., Great Neck, N.Y. Information and Communications Div.
ROCKET ENGINE ANALYZER AND DECISION INSTRUMENTATION (READI) INVESTIGATION Final Report, Phase II
E. S. Joline, R. L. Smith, D. P. Blowney, J. J. Best, J. Harrison et al Dec. 1963 300 p
(NASA Contract NAS8-4003)
(NASA CR-55842; HB-9221-0035) OTS: $18.50 ph, $9.20 mf

The Rocket Engine Analyzer and Decision Instrumentation (READI) concept comprises an onboard electronic system that analyzes the condition of a rocket propulsion system and, in the event of a malfunction, takes corrective action, either automatically or through the crew, in order to increase the probability of mission success and to insure the safety of the crew. The following items were accomplished: (1) An experimental READI system, designed for testing on an H-1 rocket engine, was constructed and subjected to extensive laboratory evaluation. This system incorporates a variety of transducers and signal processing techniques, as well as reliability enhancing techniques such as redundancy and self-check, (2) The design procedure, which was previously outlined, for defining the functional characteristics of a READI system for a particular mission-vehicle-engine complex was revised and improved. In particular, a procedure was developed for selecting the optimum system from all of the possible malfunction detection systems that could be devised. Author

N64-17695* Republic Aviation Corp., Farmingdale, N.Y.
SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY. VOLUME I: SUMMARY AND CONCLUSIONS [Final Report, Feb.-May 1963]
17 Jun. 1963 70 p refs
(NASA Contract NAS5-3189)
(NASA CR-55926; RAC-1333, Vol. 1; SSD-1027, Vol. 1) OTS: $6.60 ph, $2.30 mf

The general objectives of the study were: (1) to find the most reasonable and reliable systems for bringing maximum areas of the earth under constant observation; (2) to identify the critical scientific and engineering problem areas and the advances in technology required; and (3) to review possible system tradeoffs and alternatives, primarily to study their effect on the quality of meteorological data outputs. In this volume, results of research in the following areas are summarized: (1) system studies; (2) subsystem studies—meteorological sensors, meteorological communications, operating communications, attitude control and station keeping, power supply sub-systems, spacecraft configuration and structure, thermal control, and ground station equipment; and (3) the development of additional capability. R.T.K.

N64-17696* Republic Aviation Corp., Farmingdale, N.Y.
SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY. VOLUME 2: CONFIGURATIONS AND SYSTEMS [Final Report, Feb.-May 1963]
17 Jun. 1963 180 p refs
(NASA Contract NAS5-3189)
(NASA CR-55931; RAC-1333, Vol. 2; SSD-1027, Vol. 2)
OTS: $12.50 ph, $5.60 mf

Several combinations of subsystems are reviewed as complete spacecraft systems, including required structure and integration. These combinations were selected primarily as examples of systems feasible within different mass limits, and are associated with the boosters that will be available. Among the topics discussed are system concepts and objectives, medium-capability spacecraft, high-capability spacecraft, minimum-capability spacecraft, gravity-gradient spacecraft, spin-stabilized spacecraft, and alternate-design concepts for weight saving. R.T.K.

N64-17700* Republic Aviation Corp., Farmingdale, N.Y.
SYNCHRONOUS METEOROLOGICAL SATELLITE (SMS) STUDY. VOLUME 6: SYSTEM SYNTHESIS AND EVALUATION
17 Jun. 1963 100 p
(NASA Contract NAS5-3189)
(NASA CR-55927; RAC-1333; SSD-1027) OTS: $8.60 ph, $3.20 mf

Among the topics discussed are: (1) application of design procedures; (2) preliminary considerations—interrelationships, nonsensitive subsystems and components, and sensitive subsystems and components; (3) nonsensitive subsystems and components—sensor data transmitter, command link, telemetry link, tracking aids, communications relay link, and data-handling subsystem; (4) sensitive subsystems and components—meteorological sensors, stabilization and station-keeping subsystem, power subsystem, and structure; and (5) design procedures—performance specifications, and selection and tabulation. R.T.K.

N64-17734* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON THE PITCHING AND YAWING MOTION OF A SPINNING SYMMETRIC MISSILE GOVERNED BY AN ARBITARY NON-LINEAR RESTORING MOMENT
Maurice L. Rasmussen (Stanford U.) and Donn B. Kirk Washington, NASA, Mar. 1964 32 p refs
(NASA TN D-2135) OTS: $0.75

An analysis is presented of the motion of a missile acted upon by a conservative moment represented by an arbitrary power series of the resultant angle-of-attack. An exact expression for the frequency of oscillation is derived that involves an infinite series. A first-order approximation to this expression is least accurate for planar motion and becomes exact as the motion becomes circular. Several comparisons are made for the worst case, planar motion; these comparisons show that the approximate solutions developed agree very well with exact solutions and are, for the most part, superior to results of Kryloff–Bogoliuboff technique. Author

N64-17764* Allied Research Associates, Inc., Concord, Mass.
WEIGHT AND PERFORMANCE DESIGN INDICES FOR IDEALIZED SPACECRAFT LANDING SYSTEMS
Roger Milligan and George Gerard 13 Mar. 1964 38 p refs
(NASA Contract NASw-682)
(NASA CR-53320; Tech. Rept. 235-6) OTS: $3.60 ph, $1.34 mf

Analytical techniques are developed to determine the optimum weight and performance of an ideal landing system designed to attenuate motions, such as those experienced by a vehicle landing vertically on a planetary surface. Only the use of solid structural materials as energy absorbers is considered. It is shown that the optimum landing system weight can be related to vehicle touchdown velocity and a simple design index. It is intended that the optimum landing system weight, as determined by considerations presented in this report, serve as a standard for evaluating the relative merit of present and future landing system designs using solid structural materials. Author

N64-17778* Oak Ridge National Lab., Tenn.
A NOTE ON IMPORTANCE FUNCTIONS FOR THE SHIELDING OF MANNED SPACE VEHICLES
R. G. Alsmiller, Jr. Mar. 1964 27 p refs
(NASA Order T-7632; NASA Order R-104)
(ORNL-3583) OTS: $0.75

The tissue dose calculations of Kinney and Zerby have been used to calculate several importance functions that are of interest in the shielding of manned space vehicles. The functions considered are concerned with the dose from primary and secondary particles in the tissue, which arise from a solar-flare proton spectrum that has penetrated an aluminum shield. The secondary particles, which are produced in the aluminum, are not considered. Author

N64-17798* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEVELOPING VIBRATION SPECIFICATIONS FROM MEASURED VIBRATION LEVELS
Edward J. Kirchman 28 Jan. 1964 51 p refs
(NASA TM X-51522) OTS: $5.60 ph, $1.73 mf

This paper outlines the needs and procedures for analyzing information gained from measurement programs in order to develop comprehensive vibration test specifications. The use of statistics in developing these specifications is also treated, the requirements for the next few years are outlined, and state-of-the-art is treated. For purposes of classification, the Goddard vehicles used as boosters are broken into three generic classes; those of low-thrust, medium-thrust, and high-thrust outputs. The general type of expected vibrations from each class is shown. The use of this data in developing a specification is also reviewed. Author

N64-17811 Autonetics, Downey, Calif.
SELF ADAPTIVE SYSTEM FOR RE-ENTRY GLIDER CONTROL
Richard K. Smyth [1960] 10 p refs

This paper demonstrates that the application of adaptive automatic flight controls to advanced space vehicle missions is now feasible using state-of-the-art techniques. It is shown that the adaptive system described will maintain the dynamic response of the combination control system–vehicle essentially constant throughout a typical reentry trajectory. It is also shown that the speed of adaptation response can be made sufficiently rapid for the system to adapt to a rapidly changing environment. The stability of the described adaptive system can be analyzed by linear servo techniques. Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-17662 Air Force Special Weapons Center, Kirtland AFB, N. Mex.

PAYLOAD PLANNING FOR THE SLV-1B SPACE PROBE

Richard M. Joppa Feb. 1964 99 p refs

(AFSWC-TDR-64-1; AD-431770)

The advantages and disadvantages of using the SLV-1B as a launching vehicle are reviewed. The SLV-1B is a relatively low-cost, high-performance space probe, used principally for conducting relatively light weight experiments in the region beyond 10,000 nmi, or for conducting preliminary test flights for satellite and deep space missions. Included in the report are discussions of payload weights, apogees, environments, volumes, launch facilities, documentation, schedules, and applicable agencies in the SLV-1B program. Author

N64-17747* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LONGITUDINAL AERODYNAMIC CHARACTERISTICS AND SURFACE PRESSURE MEASUREMENTS FOR A 1/10-SCALE MODEL OF THE RAM B LAUNCH VEHICLES

Thomas C. Kelly and Robert J. Keynton Washington, NASA, Apr. 1964 40 p refs

(NASA TN D-2204) OTS: $1.00

Results have been obtained in the Langley 8-foot transonic pressure tunnel at Mach numbers from about 0.20 to 1.20 for a 1/10-scale model of the RAM B launch vehicle. Force and moment results were obtained over an angle-of-attack range from $-6°$ to $6°$, and surface pressure distributions were measured over a flare–reverse-flare transition section at angles-of-attack from $-10°$ to $10°$ at a Reynolds number per foot on the order of 3.5×10^6. The results indicated that normal-force and pitching-moment characteristics exhibit nonlinear variations over the angle-of-attack range comparable to those of the related Blue Scout Jr. vehicle, which has fin surfaces similar in arrangement and geometry to those of the present configuration. Surface pressure distributions measured over a flare–reverse-flare transition section indicate that the flow over the reverse flare first separates and then reattaches as Mach number is increased from 0.40 to 1.20. This type of flow results in sizable, abrupt pressure variations. Author

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-17020* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CURRENT STATUS OF THE SOLID-PROPELLANT FLIGHT-TEST VEHICLE

Carl A. Sandahl and James L. Raper *In* Am. Inst. of Aeron. and Astronautics AIAA Aerodyn. Testing Conf. [1964] p 196–201 refs (See N64-17013 09-01) AIAA: $5.00 members, $10.00 nonmembers

The capabilities and limitations of the staged, solid-propellant rocket vehicle system for conducting aerodynamic tests within the atmosphere are discussed. Problem areas in aerodynamics, dynamics, propulsion, and trajectory control peculiar to these systems are covered. Some cost data are included. Author

N64-17554 Joint Publications Research Service, Washington, D.C.

THE "ELEKTRON" SPACE SYSTEM

S. N. Vernov et al 23 Mar. 1964 23 p Transl. into ENGLISH from Pravda (Moscow), 15 Mar. 1964 p 3

(JPRS-23810; OTS-64-21864) OTS: $0.75

The scientific stations, Elektron-1 and Elektron-2, were launched into circumterrestrial space for the simultaneous study of the earth's radiation belts. This article discusses the significance and the apparatus of the Elektron space system. Author

N64-17608* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OPERATIONS PLAN 13-63. TELEVISION OBSERVATIONAL SATELLITE (TIROS H)

Albert G. Ferris, Harold L. Hoff, and Robert M. Rados Dec. 1963 41 p

(NASA TM X-54699; X-535-63-248) OTS: $4.60 ph, $1.43 mf

An operations plan is given to provide planning information for activities concerned with Project TIROS and to serve as a guide during the conduct of the operation. Included are: responsibilities; project organization; mission implementation; operations and control; field station operations; space communications center operations; and computing center operations. C.L.W.

N64-17611* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SATELLITE SITUATION REPORT, VOL. 4, NO. 4

1 Mar. 1964 27 p Data computed and compiled by Goddard Space Flight Center, Norad, and Smithsonian Astrophys. Obs.

(NASA TM X-51288; X-533-63-1) OTS: $2.60 ph, $1.01 mf

This satellite situation report lists objects in orbit and decayed objects as of March 1, 1964. It includes data computed and compiled by the Goddard Space Flight Center, NORAD, and the Smithsonian Astrophysical Observatory. The data listed for each object in orbit includes code name, catalog number, source, launch date, nodal period, inclination, apogee, and transmitting frequency. M.P.G.

N64-17677* Space Technology Labs., Inc., Redondo Beach, Calif.

REDUCTION AND ANALYSIS OF EXPLORER VI AND PIONEER V DATA, VOLUME I Final Report

Alan Rosen et al 30 Nov. 1962 199 p refs

(NASA Contract NASw-270)

(NASA CR-55802; Rept. 8626-6006-RU000)

The following subjects are discussed: (1) the structure, composition, and dynamics of the Radiation Belt during August

and September 1959; (2) Explorer VI Satellite observations of the geomagnetic field during magnetic storms; (3) Pioneer V data reduction and analyses; (4) an investigation of signal fading on Explorer VI and Pioneer V transmissions; and (5) satellite signal fluctuation caused by ionospheric irregularity. R.T.K.

N64-17794* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 3, NO. 4
13 Feb. 1963 7 p
(NASA TM X-51526; X-533-63-1) OTS: $1.10 ph, $0.80 mf

The following information is presented for objects launched in 1958, 1959, 1960, 1961, and 1962: code name, source, launch date, nodal period, inclination, apogee, perigee, and transmitting frequency (if applicable). R.T.K.

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-16938 Aeronautical Research Council (Gt. Brit.)
TENSILE INSTABILITY OF HOLLOW ROTATING DISCS OF UNIFORM THICKNESS
P. B. Mellor and M. J. Percy (Liverpool U.) London, HMSO, 1963 16 p refs
(ARC-CP-692) Available from HMSO: 3s. 6d.

This paper presents an analysis of conditions at instability of hollow rotating discs of uniform initial thickness. The analysis is based on Tresca's yield criterion and associated flow rule. The analysis is given more general application by assuming a strain hardening law of the form $\sigma = A\epsilon^n$. It is shown that when the ratio of outer to inner radius of a disc is greater than approximately 3.3 then, at instability the circumferential strain at the bore is always greater than the axial strain at instability in a tensile test on the same material. Author

N64-17150 Aeronautical Research Inst. of Sweden, Stockholm
ANALYSIS OF THE PROBABILITY OF COLLAPSE OF A FAIL-SAFE AIRCRAFT STRUCTURE CONSISTING OF PARALLEL ELEMENTS Final Report
S. Eggwertz and G. Lindsjo Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Feb. 1964 59 p refs
(Contract AF 61(052)-573)
(HU-961; RTD-TDR-63-4210; AD-431826)

A study is made of the probability of collapse of a fail-safe structure, consisting of a number of parallel members, subjected to a random load spectrum. A numerical procedure for calculating the probability of collapse has been developed, and evaluations have been made for an assembly of six identical, parallel members. Diagrams of the probability of collapse P versus the service lifetime T_L have been plotted for various lengths of regular inspection intervals, assuming different values of the crack initiation and strength reduction parameters introduced. Some preliminary fatigue testing of assemblies with six members has been carried out in order to study the validity of basic assumptions in the theoretical investigation. Author

N64-17161* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
ELASTIC STRESS DISTRIBUTION IN A FINITE-WIDTH ORTHOTROPIC PLATE CONTAINING A CRACK
Alexander Mendelson and Samuel W. Spero Washington, NASA, Mar. 1964 18 p refs
(NASA TN D-2260) OTS: $0.50

A method is presented for obtaining directly the elastic stress distribution in a thin, finite-width orthotropic plate with a central crack. The solution, which was obtained by the use of finite Fourier transforms, involves the solving of an integral equation for the crack opening; the stresses can then be computed by simple quadrature. The solution is valid as long as the plate width is at least twice the crack length. It is shown that the stress intensity factor is independent of the orthotropy of the material. Author

N64-17370 Forest Products Lab., Madison, Wis.
SHORT-COLUMN COMPRESSIVE STRENGTH OF SANDWICH CONSTRUCTIONS AS AFFECTED BY SIZE OF CELLS OF HONEYCOMB CORE MATERIALS
C. B. Norris et al Jan. 1964 15 p refs
(BuWeps Order 19-64-8004-WEPS; Contract AF 33(657)-63-358)
(FPL-026; supersedes FPL-1817; AD-432259)

To determine the effect of honeycomb-core cell size on edgewise compression of sandwich constructions, sandwich specimens were evaluated that had aluminum facings of various thicknesses and a solid core of Sirka Spruce in which a cell of a honeycomb-core material was simulated by a round hole. A few tests involving honeycomb cores were made, and results of these were found to agree with those of the other tests for the stress at the start of dimpling of the facings. The maximum stress in the facings of the honeycomb-core specimens was lower at failure than for the specimens with wood cores. At failure, the honeycomb-core sandwich specimens had a wrinkle-type failure in the facing, with some failure in the bond between the facing and core. An empirical formula was obtained that can be used to estimate the critical stress at which dimpling of the facing over the cell voids begins. Author

N64-17452 Midwest Research Inst., Kansas City, Mo.
RESEARCH ON PANEL FLUTTER OF CYLINDRICAL SHELLS Final Scientific Report
Ronald O. Stearman Jan. 1964 92 p refs
(Contract AF 49(638)-1189)
(AFOSR-64-0074; AD-430829)

A theoretical study was made on the panel flutter characteristics of a ring- and longeron-stiffened circular cylindrical shell at high supersonic Mach numbers. This study is an extension of an earlier program and uses the cyclic reduction procedure developed to simplify the flutter analysis. A method for extending the analysis to the lower supersonic Mach numbers is also discussed. An investigation of the aerodynamic pressures on cylindrical shells in unsteady supersonic potential flow has also been carried out. A general solution for these aerodynamic pressures was obtained that is valid at both the high and the low supersonic Mach numbers. The general solution was expressed in terms of Randall functions by reducing the unsteady flow problem to an equivalent steady flow problem through an appropriate transformation. Author

N64-17516 Aerospace Corp., El Segundo, Calif.
STRESSES IN THIN VESSELS UNDER INTERNAL PRESSURE

Norman N. Au 15 Jan. 1964 184 p
(Contract AF 04(695)-269)
(SSD-TDR-63-367; TDR-269(4304)-5; formerly ATN-63 (3304)-1; AD-431706)

Elastic stresses in thin shells of revolution under the action of internal pressure are presented. The formulas given are developed on the basis of Love's classical shell theory. The pressure vessel configurations under consideration consist of various commonly encountered head closure designs integrally joined to circular cylindrical shell sections, which may be classified as long where the characteristic length of $\beta_c \ell \geq 4.0$ or as short where $\beta_c \ell < 4.0$. In addition to the membrane stresses, the bending stresses resulting from forces and moments at the junctures of the heads and cylinders are also presented. The concept of edge influence numbers is used where it is convenient to express the discontinuity forces and moments at the junction. Many important parameters are expressed in graphical forms to facilitate analysis. Author

N64-17548 Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (W. Germany)
RECENT EXAMINATIONS OF THE THEORY OF ADHESIVE BINDING [NEUERE UNTERSUCHUNGEN ZUR THEORIE DER KLEBVERBINDUNGEN]
Olaf Volkersen [1963] 28 p refs In GERMAN

New investigations of the theory of adhesive bindings indicate that glued lap joints can be used for joining stress-loaded components, such as the sheet metal of web spars or torque tubes. The stress distribution in the adhesive layer depends upon the rigidity properties of the sheet metal and of the adhesive. In these investigations, special attention was given to the case of a symmetrical, stress-loaded, double-butt strap joint. In such a joint, the peeling stress is more important than the adhesive shearing stress. I.v.L.

N64-17551 California Inst. of Tech., Pasadena Graduate Aeronautical Labs.
INVESTIGATION OF THE FLUTTER OF A THIN-WALLED CIRCULAR CYLINDER OF FINITE LENGTH IN SUPERSONIC FLOW [UNTERSUCHUNGEN UBER DAS FLATTERN EINES DUNNWANDIGEN, KREISRUNDEN ZYLINDERS ENDLICHER LANGE IN UBERSCHALLSTROMUNG]
Hans Krumhaar (DVL, Freiburg) [1963] 18 p refs In GERMAN, ENGLISH summary
(Sponsored by AF)

A short review is given of flutter investigations for a thin cylindrical shell of finite length in a supersonic airstream with restriction to axial symmetrical modes. Using the linearized Timoshenko shell equations and the linear piston theory, the flutter problem is reduced to a non-self-adjoint, ordinary eigenvalue problem. This problem is solved without further approximations. Using these results flutter boundaries for the cylinder are derived. The reliability of the underlying physical assumptions can then be investigated by comparison with experimental results. Author

N64-17583* Rice U., Houston, Tex.
THE MOVING GRIFFITH CRACK OF UNVARYING SHAPE
L. Manshinha [1964] 19 p refs
(NASA Grant NsG-6-59; NSF Grant G-14306)
(NASA CR-53181) OTS: $1.60 ph, $0.80 mf

The propagating tensile fracture is treated as a steady-state dynamic mixed-boundary-value problem in which the displacement at the fracture surface is specified. The displacement is made to approximate a Griffith crack at all velocities of fracture propagation. Although the shape of the stress distribution curves are identical to those determined by Yoffe, the magnitude of the tensile stress immediately ahead of the fracture front decreases with increase of velocity. The applied stress necessary to make a fracture of unvarying shape propagate at any particular velocity also decreases with increase of velocity. It appears that fractures of unvarying shape propagate at a single velocity, and start and stop without acceleration and deceleration. Author

N64-17626 Wisconsin U., Madison
BENDING OF AN ELLIPTIC PLATE UNDER A MOMENT AT THE CENTER Technical Summary Report
Shun Cheng Dec. 1963 27 p refs
(Contract DA-11-022-ORD-2059)
(MRC-444; AD-433477) OTS: $2.60

A solution for elliptical thin plates bent by a concentrated moment placed at the center of the plate is sought for built-in edges and for simply supported edges. In order that the conditions given on the elliptical boundary of the plate may be described as functions of only one coordinate, elliptic coordinates are used. With the aid of tensor calculus, the expressions for moments, shearing forces, and the biharmonic equation for deflection are transformed into elliptic coordinates from their expressions in rectangular coordinates. The plates considered are assumed to be homogeneous and isotropic, and of uniform thickness. Author

N64-17627 Texas U., Austin Structural Mechanics Research Lab.
STRAIN-RATE EFFECTS IN COLD-WORKED HIGH-PURITY ALUMINUM
Charles H. Karnes Dec. 1963 91 p refs
(Contract DA-ARO(D)-31-124-G189)
(AROD-2998-2; AD-433479)

Specimens of high-purity polycrystalline aluminum were subjected to strain rates from 10^{-4} per sec to 10^{4} per sec in order to determine the nature of the strain-rate sensitivity. The specimens used in this study had been cold worked from an annealed condition to an engineering strain of 50 percent. It was found, contrary to the prediction of the intersection mechanism of dislocation theory, that the cold working had little or no effect on the type or degree of strain-rate sensitivity, and that the material used in this study was definitely strain-rate sensitive regardless of the degree of cold working. Author

N64-17638 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
CREEP AND CARRYING CAPACITY OF SHELLS
I. I. Holdenblat and N. A. Nikolayenko 7 Feb. 1964 58 p refs Transl. into ENGLISH by JPRS from Nauch. Soobshch. Akad. Stroit. i Arkhitek. SSSR (Moscow), No. 13, 1960 p 1-60
(RSIC-132; AD-432282)

Presented is the general theory of the carrying capacity and creep of shells in the presence of strong high-temperature gradients. Equations of equilibrium are given in a tensor form for shells made of isotropic and anisotropic viscous relaxing and hereditary materials. Problems in the calculation of shells are presented on the basis of a momentless theory, which assumes that the material of the shell is subordinate to the linear law of the deformation of an elastic-viscous body. These problems are also presented on the basis of the general moment theory of shells. Author

N64-17665 Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
ANALYTICAL AND EXPERIMENTAL STUDY OF THE MECHANISMS OF MONOFILAMENT FIBER FRICTION. PART I: A MATHEMATICAL MODEL FOR ADHESION MECHANISM AND A GENERAL EQUATION RELATING FIBER FRICTION TO NORMAL LOAD Technical Documentary Report [Sep. 1961-Feb. 1963]
James M. Whitney Dec. 1963 42 p refs
(RTD-TDR-63-4127, Pt. 1; AD-430181)

Equations describing the relationship between frictional force and normal load for polymeric fibers (monofilaments) have been derived. Mathematical models describing the variation of area of contact with normal load were used to develop the friction equations. The equations were checked experimentally by moving monofilaments over a cylindrical surface and measuring the friction as a function of tension. The results were compared with data obtained by other workers in the field. Friction occurring between yarns at the intersection of warp and filling has substantial effect on the mechanical properties of fabrics, and may have considerable effect on stress-strain behavior. Author

N64-17668 Douglas Aircraft Co., Santa Monica, Calif. Missile and Space Systems Div.
COMPRESSIVE CRIPPLING TESTS OF CLOSED COLUMN MEMBERS AT ROOM AND ELEVATED TEMPERATURES
Read Johnson, Jr. Aug. 1963 26 p refs
(SM-44540)

Test results are presented for compressive crippling specimens of closed, short columns constructed of formed sheet-metal hat sections. Materials tested included René 41, Inconel "X", Ti 8Al-1Mo-1V, and Ti 6Al-4V. Test temperatures ranged from room temperature upward to a maximum of 1,700° F for René 41 specimens. Author

N64-17762* Allied Research Associates, Inc., Concord, Mass.
STABILITY OF SPHERICAL PLATES
G. Lakshmikantham and George Gerard 15 Jan. 1964 27 p refs
(NASA Contract NASw-682)
(NASA CR-53318; Tech. Rept. 235-1) OTS: $2.60 ph, $1.01 mf

The stability of spherical plate elements in both elastic and fully plastic ranges is treated. Such elements fall in the transition region between axially loaded circular flat plates, where boundary conditions are significant, and spherical shells, where boundary conditions are insignificant. In this transition region a linear stability theory is used to investigate the effect of various boundary conditions and also to determine, in some detail, the regions in which the axisymmetric and asymmetric buckling modes govern. Author

N64-17772* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
BENDING TESTS OF LARGE-DIAMETER STIFFENED CYLINDERS SUSCEPTIBLE TO GENERAL INSTABILITY
Michael F. Card Washington, NASA, Apr. 1964 32 p refs
(NASA TN D-2200) OTS: $0.75

Seven ring-and-stringer stiffened, circular cylinders were loaded to failure in bending. At low loadings, portions of the skin in each of the cylinders buckled locally; the overall load distribution in the cylinders, however, could be predicted analytically up to failure. Failure of all but one of the cylinders is believed to have been precipitated by general instability. Correlation between orthotropic buckling theory and experiment was found to be fairly good, discrepancies being attributed mainly to uncertainties in two of the orthotropic stiffnesses. Efficient weight-strength capabilities of the test cylinder configuration for lightly loaded missile or aircraft applications are indicated. Author

N64-17821* Allied Research Associates, Inc., Concord, Mass.
PLASTIC STABILITY OF SIMPLY SUPPORTED SPHERICAL PLATES UNDER EXTERNAL PRESSURE
C. Lakshmikantham and George Gerard 15 Jan. 1964 17 p refs
(NASA Contract NASw-682)
(NASA CR-53358; Tech. Rept. 235-2) OTS: $1.60 ph, $0.80 mf

Plastic buckling of thin shells under external pressure is considered using the shallow shell approach. Characteristic equations are obtained for simply supported type spherical plates, and plastic buckling coefficients are determined for various values of shell geometry parameters. Author

N64-17830* National Aeronautics and Space Administration, Washington, D.C.
LONGITUDINAL-TRANSVERSE BENDING OF STIFFENED CIRCULAR CYLINDRICAL SHELLS [PRODOL'NO-POPERECHNYY IZGIB KARKASIROVANNYKH KRUGOVYKH TSILINDRICHESKIKH OBOLOCHEK]
S. N. Kan and D. Ye. Lipovskiy Apr. 1964 30 p refs Transl. into ENGLISH by Faraday Translations from Izv. Vysshikh Uchebn. Zavedeni. Aviats. Tekh. (USSR), no. 1, 1963 p 33-47
(NASA TT F-194) OTS: $0.75

This paper investigates the stressed and deformed state of stiffened circular cylindrical shells acted upon by a transverse pressure and a uniform axial load, with allowance for the initial distortions. This constitutes a continuation of Lipovskiy's investigation of unstiffened shells. Author

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-17458 Loral Electronics Corp., New York, N.Y.
DESIGN AND INVESTIGATION OF LOW FREQUENCY SPACE ANTENNAS Final Report
Myron Rosenthal Jan. 1964 84 p refs
(Contract AF 19(628)-1670)
(AFCRL-64-69; AD-432697)

Inflatable loop antennas were investigated with regard to necessary self-rigidity of the antenna, interaction between loop and supporting mechanisms, antenna packaging, method of erection, shape and location of instrument package, construction materials and sealants, and changes in electrical characteristics in a free space environment. A 20-foot Loral Inflatable Loop Antenna (LILA) has been completed, and the electrical characteristics, construction techniques, materials, and folding techniques used in its development are reviewed. Some directly related inflatable antennas that were developed simultaneously are discussed briefly. The basic strength and seaming characteristics of Mylar, the material used in the construction of LILA, were investigated, and it was concluded that Mylar is an effective material for the construction of inflatable structures. E.W.

N64-17763* Allied Research Associates, Inc., Concord, Mass.
MINIMUM WEIGHT DESIGN OF STIFFENED CYLINDERS FOR LAUNCH VEHICLE APPLICATIONS
George Gerard and Ralph Papirno 13 Mar. 1964 38 p refs (NASA Contract NASw-682)
(NASA CR-53317; Tech. Rept. 235-5) OTS: $3.60 ph, $1.34 mf

The minimum weight analysis of moderate length, grid-stiffened cylinders under axial compression is presented based on the use of orthotropic cylinder theory. The results are obtained for both rectangular and tee cross section stiffeners. The minimum weight results obtained herein are compared with isotropic, ring-stiffened, sandwich, and pressure-stabilized cylinders to establish the comparative efficiencies of each type over a broad range of the governing structural loading parameter. Finally, design data on current and projected launch vehicles indicate that all such designs fall within a very narrow range of the structural loading parameter. This observation permits a set of generalized conclusions to be drawn concerning the solution of efficient stiffening systems and materials for launch vehicle designs.
Author

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